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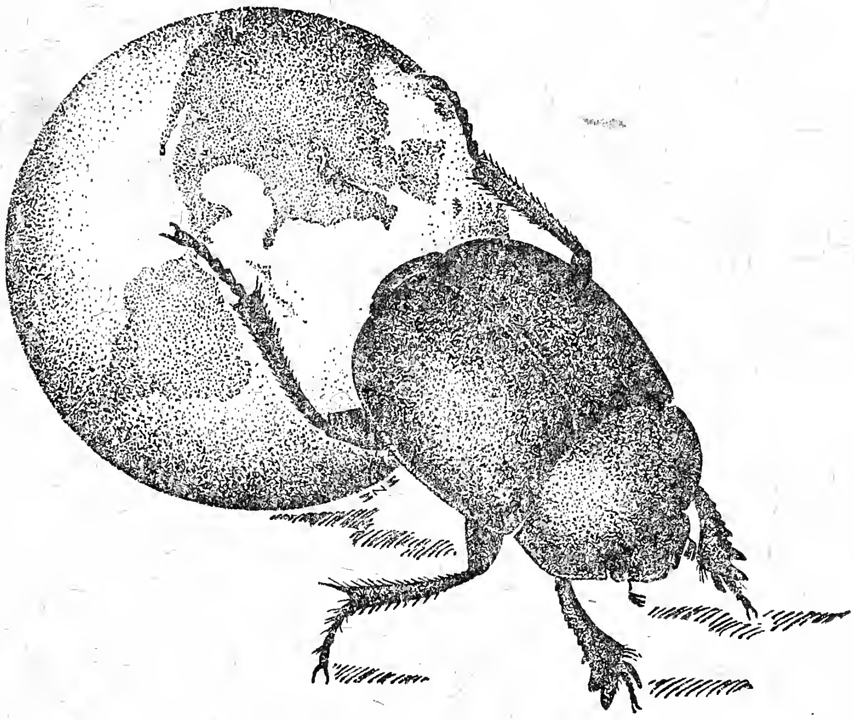

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FRANK A. SORACI

Journal of the New York Entomological Society

Vol. LXVIII March No. 1

A TRIBUTE TO FRANK A. SORACI

At the annual meeting of January 5, 1960, President Shoumatoff presented to the retiring Editor of the Journal, Mr. Frank A. Soraci, a testimonial from the Society. This expressed the deep appreciation of the Society for the service which Mr. Soraci had given to the Society during his ten years as editor of the Journal. It is certain that this appreciation is not limited to the members of the Society for, during the course of his editorship, Mr. Soraci has built up a large circle of friends. All who have published in the Journal can testify to Mr. Soraci's cordial relationship with its contributors, but few know the difficulties under which he had to carry out his duties as editor.

Mr. Soraci took his bachelors degree in Entomology at the New York State College of Forestry at Syracuse University in 1932. In the following year he was employed by the New Jersey Department of Agriculture. During his years of service with the Department Mr. Soraci held positions of increasing importance and, in 1956, succeeded Dr. Harry B. Weiss as the Director of the Division of Plant Industry. In addition to the manifold duties of the directorship, which embraced organizational work in four different Bureaus (Entomology, Plant Pathology, Seed Certification and Laboratory Service) Mr. Soraci served as chairman of the Eastern Plant Board and the National Plant Board and held other administrative posts outside the Department of Agriculture. As joint author with H. B. Weiss and E. E. McCoy Jr., Mr. Soraci has published in the Journal three major papers dealing with the reactions of insects to light. He is also the author of numerous smaller publications on the life histories and distribution of insects. During World War II Mr. Soraci was in command of a Malarial Survey Detachment and at pres-

ent holds the reserve rank of Lieutenant Colonel in the Medical Service Corps.

Mr. Soraci joined the New York Entomological Society in 1933. After serving as secretary from 1947 to 1950, he became editor of the Journal on the resignation of Dr. Weiss, who had been editor for the previous twenty-five years. His close association with Dr. Weiss enabled Mr. Soraci to take over the duties of the editor with complete success and it is unfortunate that this auspicious beginning was marred by a decision of the Society to change printers in 1953. This decision was based on the belief that the change would lead to substantial savings in the rising costs of printing. Despite warning from Mr. Soraci that the Journal might suffer from the change, the step was taken in 1954. What happened thereafter more than justified Mr. Soraci's warning, but he was forced to struggle with a situation not of his making. Finally, the Journal was more than a year behind publication date in the fall of 1956. By that time the Society recognized that the continuation of a policy which consistently delayed publication would probably lead to the Journal's demise. Mr. Soraci was instructed to resume publication through the former printer and to bring the Journal up to date as soon as possible.

The delay in the publication of the Journal had reduced contributor interest, which added to the difficulties that Mr. Soraci had to face. Nevertheless, by the end of 1959 five volumes of the Journal had been issued and its publication was back on schedule. There is every reason for the Society to feel sincere gratification at this achievement and, while Mr. Soraci acknowledges the help that various members gave, it should not be forgotten that the major burden fell on him as editor. Mr. Soraci has clearly showed that he puts the good of the Society and the Journal ahead of his own interest and that he amply deserves the esteem of his fellow-members and all friends of the Society —Wm. S. Creighton.

OBSERVATIONS OF PREY CAPTURE IN MANTIDS

BY SOL KRAMER
BIOLOGY DEPARTMENT, STATE UNIVERSITY COLLEGE ON LONG ISLAND
OYSTER BAY, NEW YORK

Several investigations have considerably enlarged our knowledge of the behavior of mantids. Although their predatory behavior is common knowledge, less well known is the fact that these insects are in turn preyed upon by other animals, including lizards, birds and mammals (Gurney, 1951). In a comparative and experimental study of mantid displays, Crane (1952) described and analyzed the innate, defensive behavior patterns which 15 species of Trinidad mantids utilize against these enemies. These defensive reactions were found to consist of four general types: 1) protective resemblance in structure and behavior (motionlessness and body attitude); 2) active escape; 3) startle display (raising of wings and tegmina and other movements); and 4) active attack. For the first time, the postembryological development of such behavior in the adults was observed from the early nymphal instars, and comparisons between species were made. As a result she was able to provide valuable insight concerning the evolution of these inherited patterns of behavior, much as the comparative morphologist provides understanding of the evolution of specific structures.

Mittelstaedt (1953, 1957), was able to analyze the sensory-motor coordination which enables mantids to hit their prey. The strike of a mantid occupies a duration of about 10–30 milliseconds. In this short duration there is clearly no opportunity for the mantid to control the efficacy of its strike by watching the difference between its direction and that of the prey. How it achieves this phenomenon of absolute optic localization has long been a problem. Although the mantid usually tends to bring its head and prothorax into one line with the prey, it is also able, as Mittelstaedt has shown and as the author has observed, to hit prey which has considerable lateral deviation from the median plane of the prothorax. The direction of the strike must therefore be based on information involving the position of the head in relation to the prothorax, as well as the position of the prey in relation to the head. Knowledge of the position of the head

in relation to the body depends on proprioceptors supplied to tens of hundreds of hair sensillae on two pairs of cervical plates. Normal mantids (*Parastagmatoptera unipunctata*) hit about 85% of the flies they attempt to capture, but if the proprioceptors of the neck region are eliminated by nerve section, the hitting performance is irreversibly reduced to 20–30%. This, however, is not the complete story, for it turns out that the head fixation line does not exactly center the prey, but deviates from it by an amount proportional to the angle between the prey and the body axis. The difference between the optic center message (a function of the angle Φ between the prey and the fixation line), and the proprioceptive center message (a function of the angle μ, between the head and the body axis), determine the fixation movements of the head which precede the release of the strike (Fig. 1). After the fixation movements have come to rest, the

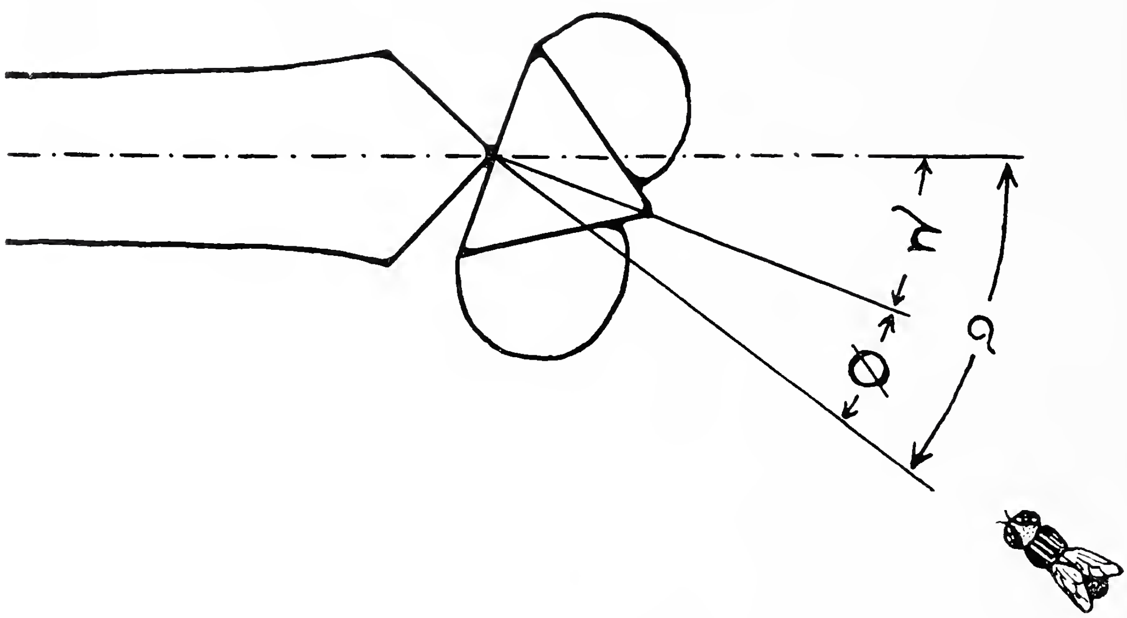

FIG. 1. Head fixation of prey which deviates by an angle σ from the line of the body axis. μ, angle between fixation line and body axis; $\emptyset$, deviation of prey from fixation line. (After Mittelstaedt, 1957).

direction of the strike is determined by information from both the optic center and (to a smaller extent) the proprioceptive center of the cervical sensillae.

Mittelstaedt's experiments, summarized above, are confined to one aspect of the problem of prey localization and capture—that of analyzing the determining factors in establishing the direction of the strike. As he himself has pointed out, there are other factors involved in prey capture, namely that of gauging the

distance of the prey, as well as other ethological questions about appetitive behavior, drives and the factors responsible for releasing the prey capture response. The following observations of prey capture in mantids, made by the author over a period of several years, should serve to illustrate the nature of some of these additional factors.

During the late summer of 1954, six adult narrow-winged mantids (*Tenodera angustipennis*) were captured by the author one evening at La Guardia Airport in New York City, apparently attracted there by the airport lights. These were kept isolated in gallon jars, and fed from time to time on late instar nymphs and adults of the cockroach, *Nauphoeta cinerea*. It soon became apparent that the response to prey varies with the physiological state of the mantid.

When a cockroach approaches or is placed before a "hungry" mantid, the mantid cocks its head in the direction of the cockroach (Fig. 2), then, when at all possible, generally moves its body

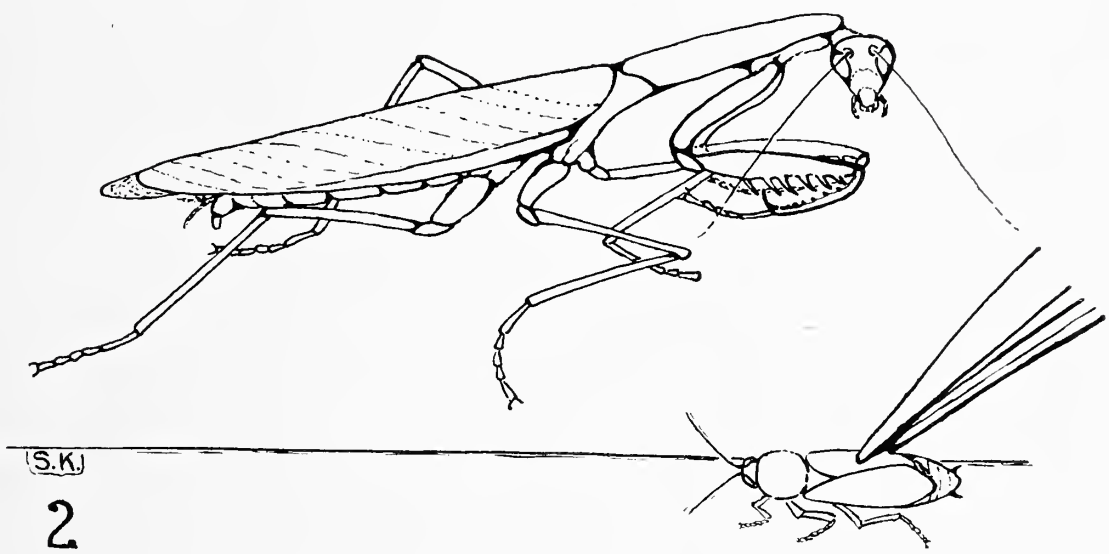

FIG. 2. Predatory response. Note movement of head towards prey.

in line with its head, so that the axis of the head, thorax and abdomen form a straight line in the direction of the cockroach. At the same time the mantid draws its forelegs towards its prothorax, and, when the fixation movements are complete, strikes at and catches the cockroach which it then proceeds to devour. Sometimes such a mantid will strike at, catch and devour a second cockroach. When it is apparently satiated, however, its response to a cockroach is completely different. It now not only draws its forelegs up, but tilts its head and thorax up, rearing

back on its mid- and hindlegs, as shown in Fig. 3, so that the body of the mantid makes a large angle with the surface on which it rests.[1] In this position the mantid remains motionless and makes no attempt to strike. After the cockroach is withdrawn, or walks away if it is free, the mantid resumes its horizontal position and also walks away. Following Crane, I have termed this a startle reaction.

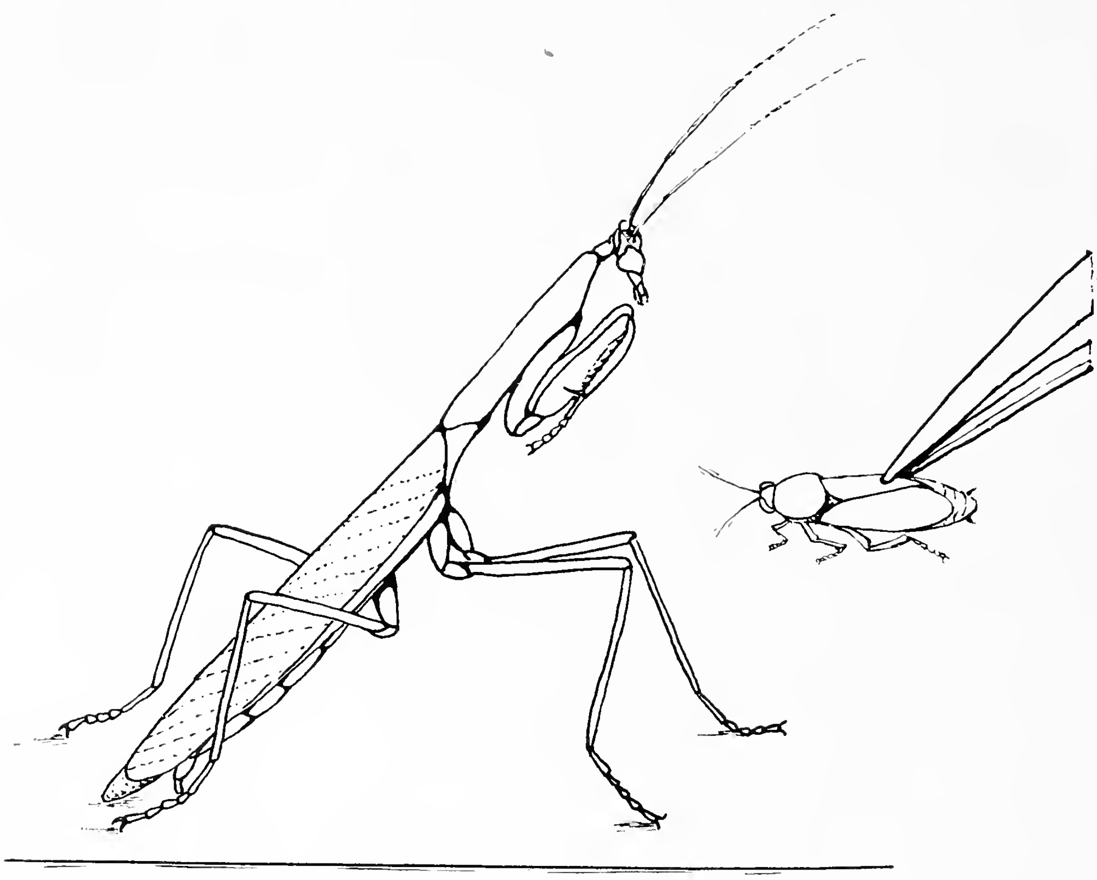

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FIG. 3. Startle reaction. Note angle of body in this reaction. One of the older common names for mantids, *rearhorse,* is derived from this characteristic behavior.

In one instance when a cockroach was placed on the floor before a satiated mantid, the mantid reared back rigidly as described above, and remained motionless. When the cockroach moved towards the left midleg of the mantid, the otherwise motionless mantid raised this leg and permitted the cockroach to

[1] According to the Century Dictionary (1889), one of the common names for these insects, *rearhorse,* is derived from this behavior. Blatchley (1920, p. 115) similarly assigns this common name to this characteristic body attitude.

crawl under it. After a short duration, the mantid walked away in the opposite direction.

These observations make it clear that the sight of moving prey may provoke two distinct responses on the part of the mantid, depending on the physiological state of the mantid. It may react with either the normal fixation response which leads to predation, or with the startle response, generally followed by escape (this latter response may also depend on the size of the prey).[2] In this and the other species of mantids described in this paper, the startle position differed from the defensive reactions described by Crane for numerous species of Trinidad mantids, in that the wings were never displayed in the many instances in which it was observed. It should be mentioned, however, that Judd (1950) has recorded that the spreading of the wings does occur in the startle response of *Mantis religiosa* described below.

In another instance a female adult of the related but larger Chinese mantid (*Tenodera aridifolia sinensis*) was captured and subsequently kept under observation. On the day it was captured, a cockroach was placed before it. It immediately cocked its head at the cockroach, quickly completed the necessary fixation movements and struck at the cockroach, which it then devoured. This mantid was subsequently placed in a rather small plastic box, approximately eight inches long by three inches in width and height, in which its movement was seriously curtailed. The following day another cockroach was offered the mantid in the same way as on the previous day. The mantid's reaction was completely different. It withdrew its entire body, and when the cockroach was brought closer, the mantid attempted to escape. On the second and third days following, the same response occurred, but on the fourth day it captured and devoured the cockroach placed before it. Again for three days, it withdrew

[2] It is possible that under more natural circumstances a mantid would not respond to an approaching insect the size of a cockroach with a startle reaction. The startle reaction in this case may, in part, be due to the method of presentation, i.e. at the end of a pair of forceps, by hand. This fact, however, by no means removes the problem, but reverses it. For when "hungry", the mantid no longer responds to the same stimulus with a startle reaction, but with fixation movements and predation. This same ambiguity has been observed when a cockroach was thrown into a jar with a mantid. The scurrying cockroach sometimes provoked escape movements, and sometimes fixation movements and predation.

from the cockroaches proffered it, but on the fourth day, it responded with fixation movements, struck at, captured and devoured the cockroach. For several days it again withdrew from insect prey.

At this point, I removed this mantid from its small box and permitted it to crawl about freely on the window screen of my study. Henceforth, its reactions to cockroaches changed, so that it now responded with fixation movements and captured at least one cockroach each day, and sometimes two a day. This suggests that other activities (energy output) influences the physiological state of the mantid, which in turn quantitatively determines the number of positive responses made to prey.

In the following year, several adult females of the European mantis (*Mantis religiosa*) were captured on September 4, 1955 in Taghkanic State Park, New York. One of these female mantids, with a gravid abdomen, refused all cockroach nymphs placed in front of it, and reacted with a modified startle reaction (it reared back, but not with as great an angle formed between it and the floor as in *T. aridifolia sinensis*) each day for a week. Two other females of the same species, kept in separate jars, reacted with a positive predatory response and ate at least one cockroach each per day. After one week I placed the above gravid female in a larger glass jar, together with grass reeds and twigs on which she might deposit her ootheca. Before doing so, however, I again tried to entice her to feed on a nymphal cockroach. This time she made several weak attempts to strike at the cockroach, but could not hold on to the prey even when she once succeeded in getting her forelegs on the cockroach. Her strike was no longer the lightning-like thrust, but considerably enfeebled. I had the impression that the mantid was debilitated and dying. Thinking she might be starved, I placed some fresh insect viscera in contact with her mouthparts. This she began to eat for a brief period with no great avidity, then shortly turned away from this food.

The mantid was now placed in its new jar. Three hours later I looked in and noticed a freshly formed ootheca around a grass reed, still moist and frothy. Once again I placed a nymphal cockroach, at the end of a pair of tweezers, in front of the mantid. The mantid's response was immediate. She quickly cocked her head towards the cockroach, drew her forelegs up and struck at

the cockroach effectively with the usual lightning-like stroke. She then devoured the cockroach avidly. Thereafter, the mantid continued to react to cockroaches with a precise and effective predatory response, often eating two or more nymphal cockroaches per day. This preoviposition period appears to be another instance in which the physiological state of the mantid strongly influences the predatory response.

In those instances above, in which prey was refused, it was noticed that the mantid also drew her forelegs towards the prothorax, as if to strike, but in this pose she never cocked her head in the direction of prey. The mantid seemed to grow rigid, and with the first opportunity, attempted to escape.

In view of the above, the following observations of early instar nymphs of the mantid, *Tenodera aridifolia sinensis*, made during the spring of 1951, 1952 and 1953, also are of interest.

Several mantid oothecae were obtained from a biological supply house each year and kept in a crystallizing dish until they hatched in the spring. In these instances the oothecae generally hatched in March and produced from 80–100 nymphs. Fairly frequent observation of these oothecae produced the impression that when they did hatch, large numbers of young mantids emerged over a short period of time. Rau and Rau (1913) similarly recorded short emergence periods for the nymphs from the oothecae of *Stagmonantis carolina*. (See also Gurney, 1951).

As they come into contact with one another, the newly emerged nymphs show a tendency to assume a ''defensive rearing back attitude'' during the first day of their lives, which suggests the startle response in the adults described above. If the newly emerged nymphs from a single ootheca are permitted to remain together in a single crystallizing dish, there is an almost ceaseless pattern of activity. Young mantids scramble over and around each other, sometimes rear back defensively, and rush away from each other. When several score of adult *Drosophila* flies were introduced into such dishes, on the second day of emergence, only an occasional attempt by some mantids to catch flies was observed, and few were successful. Several mantids struck at flies, but released or lost them as the flies struggled.

By the afternoon of this second day, very few flies had been captured and eaten, judging by the number of wings on the white filter paper floor of the dish in which they were kept, and

by the numbers of flies still present. Several of these same mantids, however, were isolated together with 2 or 3 flies in small homeopathic vials, with a strip of filter paper serving as a floor. Kept in this way, many of the day old (actually about 30 hours old) mantids caught and ate flies in their vials within the first hour of isolation. One mantid placed in such a vial made an immediate attempt to strike at a fly which came within its reach, but lost it as the fly struggled away. Within 30 seconds, however, it succeeded in capturing a fly which it devoured. These observations indicate that the predatory response to moving prey is innate, although one or two attempts may be required in some instances to perfect it.

The general impression gained from these observations was that the nervous activity of large numbers of newly emerged nymphs, when kept together, prevented the alert attitude which precedes fixation movements and the subsequent capture of flies. When young mantids are isolated in separate vials they are capable of catching prey by the thirtieth hour of their lives, and possibly earlier. If large numbers of newly hatched mantids continue together, however, they begin during the second, third and fourth days to prey on each other until their numbers are sharply reduced within a short period.

Kept in isolation in these homeopathic vials, individual mantids were easily reared through the second, third and even later instars, and their behavior observed. Three or four *Drosophila* were placed in each vial every day, and these were soon caught and devoured. The response of a young mantid to a fly, however, likewise differs, depending on its physiological state. A "hungry" young mantid immediately cocks its head on seeing a fly, and even continues to follow the fly with its head if the fly moves away from it. If the fly approaches, it also draws its forelegs up preparatory to striking. By contrast, a young mantid that has eaten its fill, no longer cocks its head at passing flies, and does not assume a preparatory striking position. If a passing fly comes too close to a satiated mantid, the latter sometimes remains rigid or moves away. It is a striking behavioral observation to introduce half a dozen fruit flies into a vial and watch the young mantid cock its head, fix, strike and devour first one fly, then repeat this response towards a second and third fly, possibly a fourth, then completely ignore the other two flies in

the vial. Here again it is clear that the physiological state of the mantid very early modifies the predatory reflex.

Further observations on these early instar mantids suggest that the response to a fly is a complex one, and not only differs from satiation to hunger, but also from moderate to extreme hunger. Flies introduced into these vials often walked on the clear, glass roof side of the vial, and cast a moving shadow on the filter paper floor, in the lighted windowless room in which they were kept. Moderately hungry mantids, that is, mantids fed every 24 hours, were never seen to respond to the moving shadows of flies. On the other hand, extremely hungry young mantids, which had not been fed in 48 or more hours, were sometimes observed to strike at the shadows of moving flies, two or three times in succession in some instances. Since these mantids had had prior fly catching experience, it cannot be assumed that the mantids had not ''learned'' to differentiate between moving flies and moving fly shadows. This suggests that an extremely hungry mantid responds with a predatory response to fewer releaser signals, than a moderately hungry one.

In addition, extremely hungry young mantids (fed after an interval of 48 or more hours) were sometimes seen to actively pursue flies, that is, to follow them by actively moving in their direction, whereas moderately hungry mantids were content to wait patiently in position until the fly approached within striking distance of the mantid. (See also, Gurney, 1951, p. 343.)

SUMMARY

Adult mantids (*Tenodera angustipennis*) will fix, strike and devour prey (cockroaches) presented to them when hungry; when not hungry they respond with a startle reaction to the same stimulus.

One adult mantid (*Tenodera aridifolia sinensis*), confined in a small cage so that its movements were limited, reacted with a predatory response and devoured a cockroach presented to it about every fourth day; on the days between it responded to the same stimulus with a startle reaction and escape movements. The same mantid allowed to roam freely around a window screen, gave a predatory response at least once and sometimes twice a day, to the same cockroach stimulus.

A gravid female mantid (*Mantis religiosa*) reacted with a

startle response or made ineffective, enfeebled strikes at a cockroach presented to it daily for one week prior to oviposition. Immediately after oviposition she effectively fixed, struck and avidly devoured cockroach nymphs daily. Two other non-gravid female adults of this species gave positive predatory responses to cockroaches almost daily.

Newly hatched first instar nymphs of *Tenodera aridifolia sinensis* fix, strike and catch *Drosophila* after isolation in a vial, when presented with flies for the first time at 30 hours of age, possibly earlier. The first predatory response may be completely successful or soon becomes successful after one or two failures.

Thereafter, moderately hungry mantid nymphs (fed every 24 hrs.) fix, strike and devour from 1–4 passing *Drosophila* in fairly quick succession but when satiated they ignore *Drosophila* which walk past them.

Extremely hungry mantid nymphs (fed every 48 hrs.) will strike at moving shadows of *Drosophila* (which moderately hungry mantids were never observed to do) even after considerable, previous fly-catching experience.

Extremely hungry nymphs will actively crawl after and pursue moving prey, whereas moderately hungry nymphs normally wait quietly in place until a fly comes within striking distance.

These observations indicate that the predatory response (consisting of fixation movements at the sight of prey, and the rapid strike) is very early integrated with and modified by various physiological states of the mantid.

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OBSERVATIONS ON SOME MATINAL BEES AT FLOWERS OF CUCURBITA, IPOMOEA AND DATURA IN DESERT AREAS OF NEW MEXICO AND SOUTHEASTERN ARIZONA

By E. Gorton Linsley
University of California, Berkeley

Although some of the crepuscular and nocturnal bees which collect their pollen during the evening hours have received considerable study [for a summary, see Linsley (1958)] little serious attention has been given to matinal species until recent years [Michener (1947); Linsley, MacSwain and Smith (1955a, 1955b, 1956); Linsley and MacSwain (1956); MacSwain (1957); Linsley and Hurd (1959)]. The bees involved fall into two classes: (1) oligolectic species which are closely synchronized with the periods of pollen availability in their host plant (*Lasioglossum lustrans* Cockerell, certain anthophorids, some *Andrena*), and (2) polylectic species which, when conditions permit, extend their foraging activity into the early morning hours and offer competition to the matinal oligoleges (some anthophorids; *Agapostemon* and a few other halictines; carpenter bees; bumblebees; and honey bees).

The following observations, although fragmentary, are intended to contribute to our knowledge of the general subject of matinal bees. They were made primarily in the vicinity of the Southwestern Research Station of the American Museum of Natural History, near Portal, Arizona. The writer is indebted to Dr. Mont A. Cazier, Director, for making the facilities of the station available as a base for these and related studies.

Cucurbita

The most conspicuous North American oligolectic bees associated with *Cucurbita* belong to the closely related eucerine genera of anthophorids, *Xenoglossa* Smith and *Peponapis* Robertson. Cockerell (1896) was one of the first to call attention to this relationship. At 9 a.m. on June 21, 1896, he opened fresh flowers of *Cucurbita perennis* growing at Mesilla, New Mexico and found

males (one to a flower) representing three species now known as *Peponapis pruinosa pruinosa* (Say), *Xenoglossa patricia* Cockerell, and *X. strenua strenua* (Cresson). On the following day he examined the flowers earlier (at 7:45 a.m.) and again captured a number of males, along with one female of *X. patricia* and four females of *X. s. strenua.* Cockerell did not mention whether the females were gathering pollen but it is likely that they had already completed this activity [Robertson (1925) reported *P. p. pruinosa* visiting *Cucurbita pepo* before sunrise in Illinois; Linsley, MacSwain, and Smith (1955a) found *X. fulva* Smith active at dawn in Mexico].

Although the eucerine anthophorids were the predominant bees found at *Cucurbita* by Cockerell, he reported the presence of honey bees, which "seemed disconcerted to find fat *Xenoglossae* at the bottom" of the flowers, as well as *Agapostemon texanus* Cresson. Robertson reported six additional species of bees at *C. pepo* in Illinois and Fronk and Slater (1956) found a number of others, mostly halictines, visiting *Cucurbita maxima,* and to a lesser extent *C. pepo,* in Iowa. In addition, these authors record *X. s. strenua* and *P. p. pruinosa* from the related cucurbit *Lagenaria siceraria.*

During the summer of 1959, near Portal, Arizona and Rodeo, New Mexico, four species of eucerine anthophorids were found visiting *Cucurbita* but not more than two were found together at any one site. Two orange-flowered species of *Cucurbita* were involved, *C. foetidissima* and *C. digitata.* The yellow-flowered *Apodanthera undulata,* which grew along with them, was not visited by bees of any kind while it was under observation.[1] Notes from the three principal sites may be summarized as follows:

Southwestern Research Station, Chiricahua Mountains, 5 miles west of Portal, Arizona. At this site *Cucurbita foetidissima* was growing in a dense patch from 40–50 feet in diameter near the

[1] It is interesting to note that in the Salt River Valley of Arizona, cantaloup flowers open between 7 and 8 a.m. McGregor and Todd (1952) found that honey bees were the only pollinators present in that area and without them commercial production of cantaloups was impossible. Their activity began shortly before noon. Possibly the late opening of the flowers explains the absence of native bees, or perhaps, as in the case of *Apodanthera,* the flowers are not attractive to them.

main laboratory building and in smaller, scattered clumps elsewhere. On July 18, the flowers were examined at 5 a.m. MST (Temperature: 52° F). Between 75 and 80 flowers were open and female *Peponapis p. pruinosa* (Say) were actively gathering pollen. They were joined at 5:35 a.m. by a honey bee and a female of *Agapostemon angelicus* Cockerell. By 5:55 a.m. (Temperature: 54° F) a second honey bee had appeared and *Peponapis* activity had fallen off markedly. During the next hour a few females returned for nectar but no males were noted until 7 a.m.

At the same site three days later, the first females of *Peponapis* were gathering pollen at 4:55 a.m. (Temperature: 59° F). It was too dark to see them without a flashlight, but they could be followed readily because of their loud buzzing. By 5:05 a.m., the flying bees could be distinguished but there was not yet enough light to see into the flowers. At 5:10 a.m. the bees could be seen in the flowers and their buzzing fell off noticeably. The first honey bee appeared at 5:19 a.m., and at 5:25 a female of *Xenoglossa patricia* Cockerell was taking pollen. By this time, pollen-collecting *Peponapis* had largely disappeared (one straggler was found at 5:37 a.m.) and honey bees were becoming more abundant. Observations were terminated at 6:15 a.m. without the appearance of males of either *Peponapis* or *Xenoglossa*. A check of the flowers at 9 a.m. yielded a few males in the flowers facing outward.

On July 28, the flowers were examined at 4:30 a.m. At 4:50 (Temperature: 64° F) *Peponapis* were heard flying and identified by flashlight. By 5:04 a.m. they could be seen without the light. The first honey bee appeared at 5:15 a.m. and female *Xenoglossa* were collecting pollen at 5:22 and 5:23 a.m. The last *Peponapis* with a load of pollen was seen at 5:47 a.m. By this time honey bees were abundant.

The importance of honey bees in cucurbit pollination is a subject upon which there is a diversity of opinion [Fronk and Slater (1956)]. Since none were seen at other localities, observations were made only at the above site, where the bees are naturalized, living in hollow trees, etc. On July 18, 21, and 28, the first honey bees appeared at *Cucurbita* flowers at 5:35 a.m. (Temperature: 53° F), 5:19 a.m. (Temperature: 58° F), and 5:15 a.m.

(Temperature: 64° F) respectively, in each case about the time pollen collecting by *Peponapis* began to fall off. They extracted pollen from the flowers with great difficulty, scraping it from the stamens in small amounts with the front legs. After each scraping the bees left the flower, poised on the wing in front of it for 10–15 seconds and transferred the pollen to the hind legs before re-entering. After repeating this procedure several times, the bees usually rested on the flower lip, or on a leaf, and worked the pollen into the load before moving to another blossom. At other times they crawled over the leaves or rested with the abdomen pumping. Most of the honey bees carried very small pollen loads in contrast to those of *Peponapis* and *Xenoglossa*. Possibly this was because they followed these anthophorids, as pollen scavengers.

At a second site, two miles northeast of Portal, a few plants of *Cucurbita foetidissima* were growing on a bank. It was not possible to visit this site at dawn, but the few available flowers were examined twice at about 9 a.m. On August 2, wilted flowers contained three males of *Xenoglossa patricia* Cockerell and two of *X. s. strenua* Cresson. The following day they yielded two males and two females of *X. patricia* (the females without pollen), a male of *X. s. strenua* and a female of *Agapostemon melliventris* Cresson (without pollen).

The third locality was five miles south of Rodeo, New Mexico, where a few plants of *Cucurbita foetidissima* were growing along the roadside intermixed with the somewhat smaller flowered *C. digitata* and the yellow flowered *Apodanthera undulata*. *Xenoglossa patricia* collected pollen before sunrise from both species of *Cucurbita* but not from *Apodanthera*. On July 31, the site was visited at 5 a.m. (Temperature: 60° F). *Xenoglossa* females were actively collecting pollen and continued to do so until 6:40 a.m., 50 minutes after sunrise. Males first appeared at 5:15 a.m. and cruised the flowers as long as females were active. Females of *Agapostemon melliventris* began gathering pollen at 5:13 a.m. and were fairly numerous until the pollen began to run out about 6:30 a.m. A male of an undescribed species of *Peponapis* was cruising at 6:12 a.m., but no females appeared.

On August 4, the site was visited at 4:45 a.m. (Temperature 55° F). Few flowers were open and the sky was overcast and

threatening rain. Females of *X. patricia* and *A. melliventris* were already actively gathering pollen but by 5:15 a.m., 42 minutes before sunrise, the pollen was exhausted. A few females of *Xenoglossa* took nectar from the flowers until about 6 a.m., and males continued to cruise and take nectar during this same period. At 5:47, a female without pollen tested the soil at the edge of the road for about 10 minutes in search of a suitable nest site, but she flew off without starting an excavation.

At the two very different sites where five complete flight counts were taken (5 miles West of Portal and 5 miles South of Rodeo), the initiation of pollen gathering activity for *Xenoglossa* and/or *Peponapis* only varied from 4:50 a.m. to 5:04 a.m., although the air temperatures ranged from 52° F to 64° F. On these same days, the arrival time of the first polylectic pollen collectors, *Apis* and/or *Agapostemon* lagged on the average by nearly 24 minutes. The greatest lag, 35 minutes, occurred when the air temperature was lowest (52° F) when the flight of *Peponapis* started.

Ipomoea

The genus *Ipomoea* (*Convolvulaceae*) contains numerous species which make their pollen available very early in the morning. The principal pollinators reported thus far are oligolectic bees, including *Ptilothrix sumichrasti* (Cresson) [Linsley, MacSwain and Smith (1956)] and various species of *Melitoma* [Robertson (1925); Michener (1951); Linsley, MacSwain and Smith (1956)]. Little has been published regarding the pollen collecting activities of these bees, although Robertson observed *Melitoma taurea* (Say) visiting *Ipomoea* flowers before dawn in Illinois.

Melitoma grisella (Cockerell and Porter) is also a matinal pollen collector. On July 13, 1959, at 7:15 a.m. MST (Temperature: 70° F), near Los Montoyas, New Mexico, this species was very abundant about the blue-flowered *Ipomoea leptophylla* Torrey. However, by this time all of the pollen had been removed from the stamens. A few females were visiting the blossoms for nectar and relatively large numbers of males were cruising the flowers. The males flew very rapidly, occasionally popping in and out of flowers. During the next two hours,

large numbers of solitary bees and honey bees were observed taking nectar from *Melilotus alba* in the vicinity of *Ipomoea,* but these did not include either sex of *Melitoma.* Conversely, only one species which was taking nectar from *Melilotus* was also found on flowers of *Ipomoea,* a female *Svastra.* Three other bees, two males of *Diadasia* which had apparently strayed from nearby plants of *Sphaeralcea* where their females were gathering pollen, and a male of the *Oenothera* oligolege *Chloralictus* (*Sphecodogastra*) *texanum* (Cresson), also visited *Ipomoea* during this period. This provided a marked contrast to the intense activity of *Melitoma.*

A beetle competitor, *Euphoria kerni* Haldeman, like its Mexican counterpart *E. basalis* Gory & Percheron, feeds on the floral parts of *Ipomoea* and interferes with pollination. The leaves of *I. leptophylla* were also heavily infested with adults and larvae of the chrysomelid *Chelymorpha cassidea* (Fabricius), less heavily with *Metriona bicolor* (Fabricius).

Datura

Apparently, very few bee visitors have been reported for any of the native or naturalized species of *Datura* (*Solanaceae*) which grow in the desert areas of southwestern United States and northern Mexico. Cockerell and Porter (1899) captured the matinal colletid *Caupolicana yarrowi* (Cresson) at *Datura* flowers between 5:15 and 6:15 a.m., but did not indicate whether or not pollen was being collected. Graenicher (1930) records a female of this species at flowers of *Antigonum* (without stating whether it was taking pollen) and Linsley and Hurd (1959) found males at Granite Pass, New Mexico taking nectar from flowers of *Larrea divaricata* Cav. before sunrise. Near Portal, Arizona in early August, I found them visiting *Melilotus alba* under similar circumstances but was unable to locate the pollen source (or sources) of the female. According to Michener (1951) the species is not oligolectic.

Most species of *Datura* have large, conspicuous, white or purplish-white flowers and make their pollen available in the evening. At a series of localities in the vicinity of Portal, Arizona and Rodeo, New Mexico, I twice examined flowers in the early evening without finding any pollinating insects, although al-

leculid beetles were usually present along with scarabs of the species *Cyclocephala* (*Dichromina*) *dimidiata* Burmeister. These fly to the flowers shortly after they open in the evening and remain in them until they wilt the following day. Both are nectar feeders and although they block the area of the nectaries they usually remain below the stamens and do not interfere with pollination. Bees visit the flowers in the early morning, but by that time the pollen is largely gone (removed by sphinx moths?).

On July 17, 1959, at Granite Pass, New Mexico, blossoms were examined by flashlight at 4:56 a.m. The air temperature at that time was 70° F and females of *Agapostemon melliventris* Cresson and worker honey bees were taking nectar and scavenging for pollen. During the next 15 minutes they were joined by several females of *Xylocopa californica arizonensis* Cresson and workers of *Bombus sonorus* Say, each of which seemed to be seeking nectar, but by 5:15 a.m. activity had fallen off and only a few honey bees remained, crawling over the dry stamens. By the time the sun rose at 5:32 a.m. all activity had ceased.

On July 31, 1959, 5 miles south of Rodeo, New Mexico, *Datura* flowers were again examined by flashlight shortly after dawn. At 4:30 a.m. (Temperature: 60° F), there was no insect activity, although the pollen was practically all gone from the stamens. The air temperature remained fairly steady until the sun rose at 5:50 a.m. By 6 a.m. it was 64° F and females of *Agapostemon melliventris* Cresson began to appear and scavenge for pollen. By 6:15 a.m. (Temperature: 66° F) males and females of *Agapostemon* were active about the flowers, the females primarily seeking nectar, but after 6:30 a.m. their numbers fell off very rapidly.

The contrast in the activity periods of the bees on these two days suggests that temperature may be a greater limiting factor than light intensity for polylectic species which are not primarily adapted for visiting flowers during the early morning hours.

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ON THE SYSTEMATIC POSITION OF TWO GENERA ERRONEOUSLY PLACED IN THE FAMILY TORTRICIDAE (LEPIDOPTERA)

By NICHOLAS S. OBRAZTSOV[1]

Syncamaris Meyrick

Type species: *Syncamaris argophthalma* Meyrick, 1932.

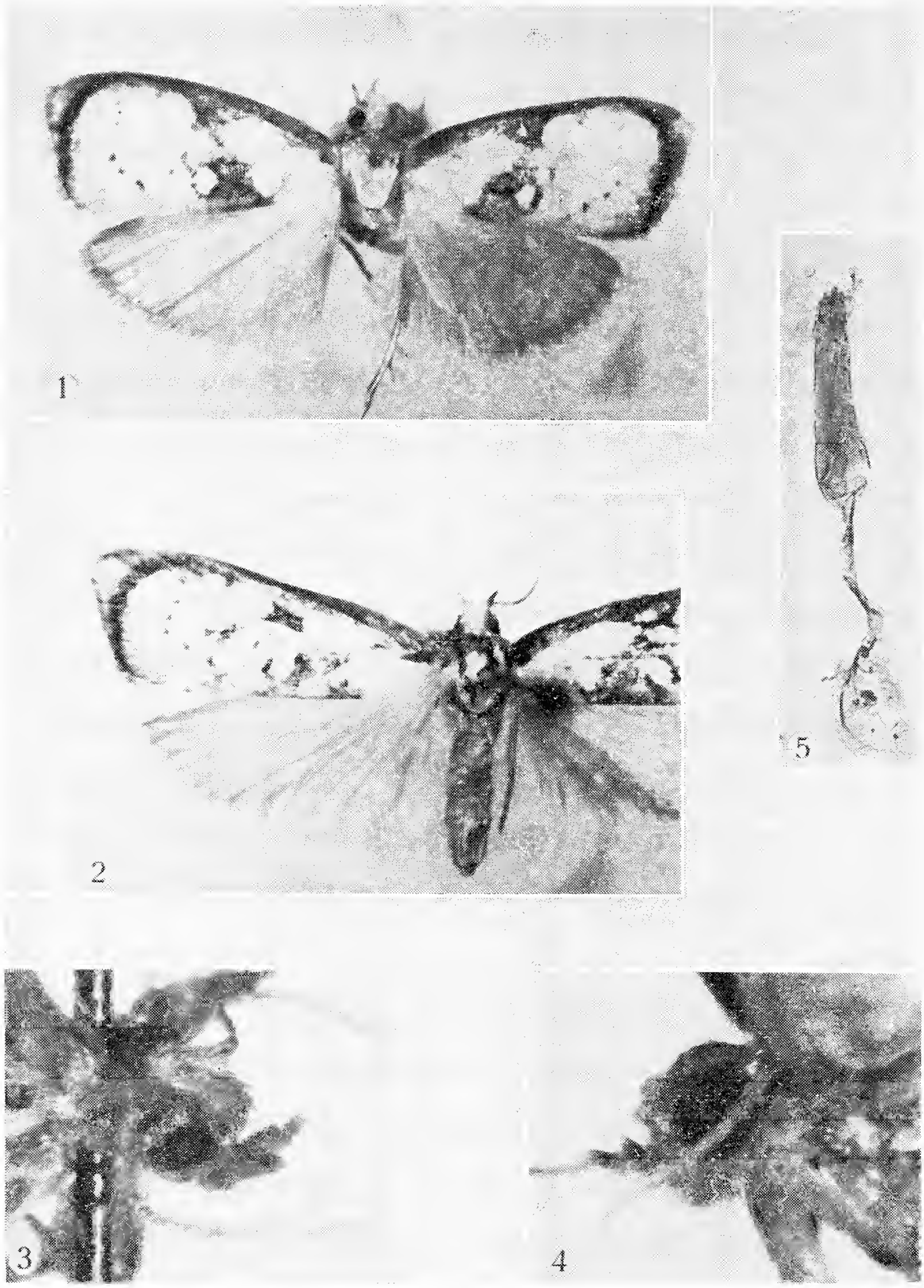
Syncamaris Meyrick, 1932, Exotic Microlepidoptera **4**, p. 262.

From the Museum of Natural History (Naturwissenschaftliches Museum) in Vienna, the present author received some material for examination, among it three male specimens of *Syncamaris argophthalma* Meyrick (plate I, figures 1 and 2), the type species of the monobasic genus *Syncamaris* which Meyrick described as a member of the family Tortricidae. All these specimens are labeled as collected by F. Hoffmann in Santa Catharina, New Bremen, Brazil. Two of them were recorded on June 12, 1931, and one on August 9, 1936. In the original description of this species Meyrick mentioned only one specimen, and this was probably that one taken on June 12, 1931, of the received series, which has an identification label by Meyrick. This specimen should be considered to be the type. The examined material gives an opportunity to publish some additional data about the genus *Syncamaris,* and to ascertain its systematic position.

The original description of the genus *Syncamaris* is quite accurate. It reads: "Antennae ♂ ciliated. Palpi moderately long, obliquely ascending, second joint thickened with loosely appressed scales, terminal joint short, obtuse. Thorax smooth. Forewings 2 from ¾, 3 from before angle, 4 and 5 approximated at base, 7–9 approximated at base, 7 to below apex. Hindwings with loose cubital pecten; 3 and 4 nearly approximated at base, 5 parallel, 6 and 7 nearly connate, 8 closely approximated to cell to beyond origin of 7." The details of the wing venation are seen from a drawing made by the present author (figure 1). In addition to the characters mentioned in the original description, it

[1] Research fellow of the American Museum of Natural History. This work has been done under the auspices of the National Science Foundation.

(JOUR. N. Y. ENT. SOC.), VOL. LXVIII (PLATE I)



Explanation of Plate I
Syncamaris argophthalma Meyrick

1. Male, type.
2. Another male (recorded on August 9, 1936).
3 and 4. Head of the type specimen.
5. Aedoeagus of the type specimen.

should be said that the head (plate I, figures 3 and 4) is loosely appressed scaled, the antennae very slightly serrated, the legs are smooth except for the fore femora which are long pectinated along their lower edge. On the hind wings, besides a long cubital pecten, there is another one at the base of the vein A_2.

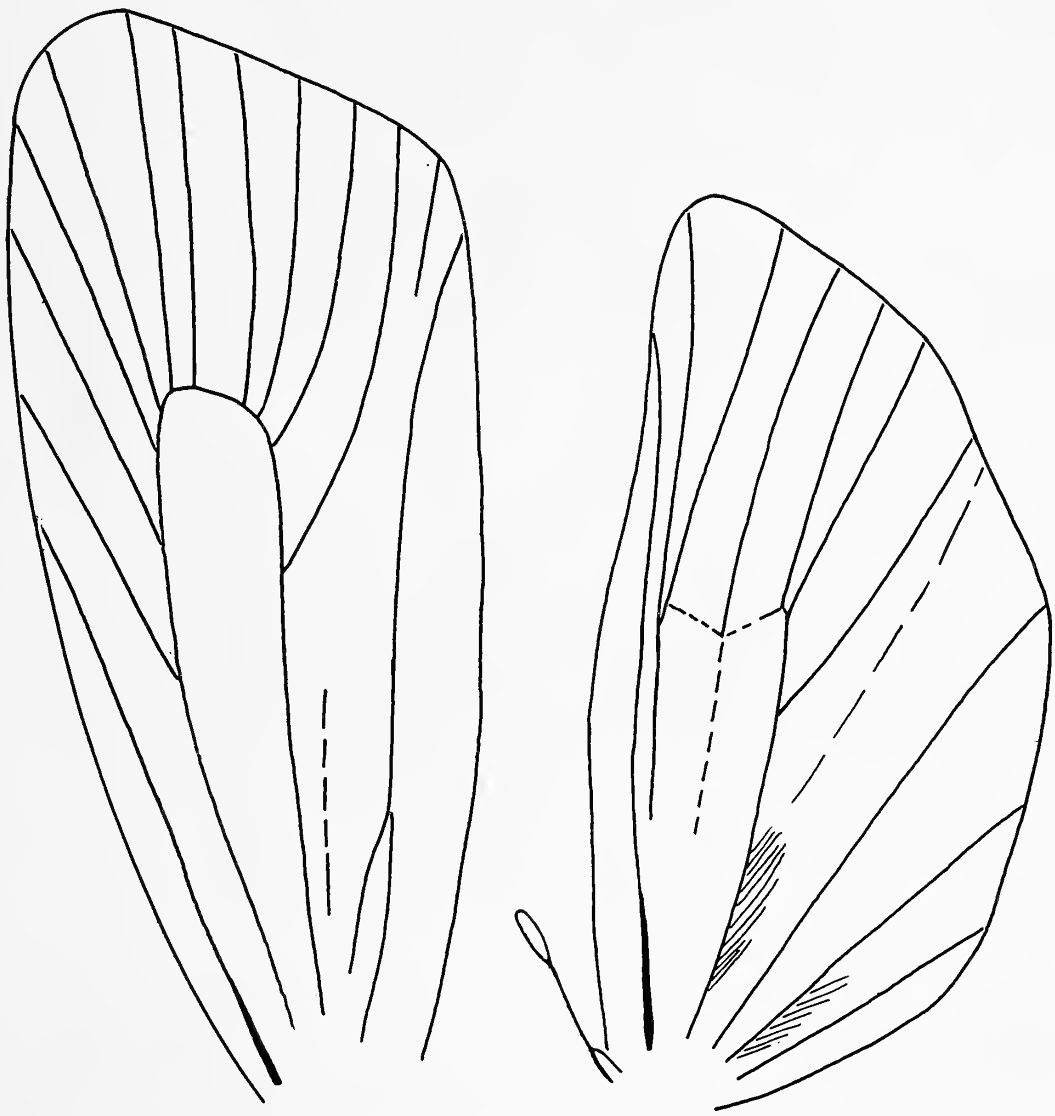


FIG. 1. Wing venation of *Syncamaris argophthalma* Meyrick.

Very peculiar, and not mentioned by Meyrick, is a frenulum thickened at the tip. A similar capitate frenulum has previously been observed in two other genera, *Neophylarcha* Meyrick and *Rhopalosetia* Meyrick, both from French Guiana. According to Clarke (1955, Catalogue of the type specimens of Microlepidoptera in the British Museum described by Edward Meyrick; **2**, pp. 523 and 531), these two genera belong to the family Copromorphidae. The genus *Syncamaris* should probably have been placed near these genera.

Besides a capitate frenulum, all three of the above genera

have another character distinguishing them from the remaining Copromorphidae, namely an obtuse terminal joint of the labial palpi, and perhaps deserve separation as a new family. It is, however, untimely to establish this family for three genera, since Copromorphidae include also many other genera of unascertained relationship, and need a detailed and careful revision. Until this revision is done, it seems better to place the genus *Syncamaris* in the family Copromorphidae.

FIG. 2. Male genitalia of *Syncamaris argophthalma* Meyrick (type).

The male genitalia of *Syncamaris argophthalma* (figure 2) are not quite similar to those known in the Copromorphidae genera. The valvae of this species are firmly joined along their inner edges to the vinculum, and the lower edges of the sacculi are connected to the saccus. To make a proper mounting of the genitalia on a slide, one of the valvae (the right on the present slide) should be cut away from the vinculum. The vinculum

(including the tegumen) is rather narrow and joined ventrad to a very large saccus. No uncus is present. On the dorsal surface of the anal tube there are two longitudinal folds leading to two weak, haired pads. This whole area could probably be included with the scaphium. No gnathos and fultura superior are present. The fultura inferior is entirely membranous. The valvae are bipartite, and each consists of a broad, haired, lancet-shaped sacculus and a narrow, bent valvula with a slightly dilated cucullus. The aedoeagus (plate I, figure 5) is slender and is joined to the fultura inferior by the tip. There are no cornuti. The entire genitalia are very weakly sclerotized.

Tapinodoxa Meyrick

Type species: *Tapinodoxa autonephes* Meyrick, 1931.

Tapinodoxa Meyrick, 1931, Exotic Microlepidoptera. **4**, p. 154.

This monobasic genus was established for a new species from Paraguay, known to its author in three specimens. Meyrick believed that all of the above specimens of his *Tapinodoxa autonephes* were males, but the two specimens, which the present author received for examination from the Museum of Natural History in Vienna and which were sent to him as belonging to the original series, appeared to be females. Both of them are dated "Paraguay, Asuncion, F. Schade, 1920–21," and have red labels reading "Type." Only one of these specimens has an identification label in Meyrick's handwriting, and it is therefore advisable to select it as lectotype.

Writing about the sex of the above specimens, Meyrick was probably confused by the frenulum which in the female of *T. autonephes* consists of a single bristle. He also described the proboscis as being absent. As a point of fact it is present, although it is rudimentary. Meyrick wrote that the thorax of *T. autonephes* is smooth, but in a specimen in better condition the present author observed a distinct posterior crest of the thorax (the pin goes through its middle). In the other specimen the scales of the thorax are completely rubbed off. A further mistake of Meyrick was to assert that the forewing vein Cu_1 (= 3) arises from near the cell angle. In both specimens of the Vienna Museum this vein originates directly from the lower angle of the middle cell, and is closely approximated to the vein

M_3 (= 4). The vein Cu_2 originates at about four-fifths of the middle cell. Since the two specimens examined by the present author were females, it was impossible to prove if any costal fold is present in the male of *Tapinodoxa*. Therefore, the absence of a costal fold in the male, mentioned by Meyrick as one of the morphological characters of this genus, should be considered as unproven.

Some further characters of the genus *Tapinodoxa* deserve to be mentioned. The vein R_1 (= 11) of the forewing originates at the middle of the middle cell, and is very remote from R_2 (= 10) at base, although both of these veins are closely approximated and parallel to each other on their way to the costa. The vein A_1 is developed as a fold not reaching the tornus. The forewing vein A_{2+3} (= 1) and Cu_2 (= 2) are approximated to each other at the tornus. These characters are recognized as typical of the family Phaloniidae, and the present author is inclined to place *Tapinodoxa* in this family. The female genitalia of *T. autonephes* with their large ostium bursae developing gradually into the corpus bursae also remind one of this family.

A detailed description of the genus *Tapinodoxa* and determination of its systematic position in this family will probably be made by some future investigator of the neotropical Phaloniidae. The purpose of the present note, done in connection with a revision of the genera of the Tortricidae, is to show that *Tapinodoxa* does not belong to this family.

The author wishes to acknowledge with thanks the cooperation of Dr. R. Schönmann of the Vienna Museum of Natural History who sent him the material on the genera discussed in the present paper.

EFFECTS OF TEMPERATURE AND PARENTAL AGE ON THE LIFE CYCLE OF THE DARK MEALWORM, *TENEBRIO OBSCURUS* FABRICIUS*

BY CARL FIORE
Department of Biology, Fordham University

Arendsen Hein (1923) found that the optimal temperatures for both the yellow mealworm, *Tenebrio molitor,* and the dark mealworm, *T. obscurus,* were between 25° to 27.5° C. He counted 10 to 14 molts for *T. molitor,* but he did not observe the number in *T. obscurus.* With proper food, temperature and humidity, the average larval period lasted from 6 to 8 months for both species. Cotton and St. George (1929) reported that the dark mealworm had an egg stage which varied from 4 to 7 days at 80° to 88° and from 17 to 18 days at 65° F. The pupal stage of this species was found to be 7 days at 77° to 78° and 20 days at 65° F.

The number of larval molts may also vary with temperature. Ludwig (1956) found 11 to 15 and 15 to 23 larval molts for *T. molitor* at 25° and 30° C., respectively. Tracey (1958), working with this species, observed that at 25° and 30° C. at a relative humidity of 75 per cent, the duration of the larval stage and the number of larval molts were greater at the higher temperature. Larvae obtained from eggs laid by beetles 1 week after emergence had an average larval life of 153.7 days and had 13.7 molts at 25°; while at 30° C., these values were 168.0 and 15.8, respectively.

Parental age may also affect the duration of the life cycle. Ludwig (1956) observed that in *T. molitor* the length of larval life was diminished in the progeny of older beetles. In this species, Tracey (1958) found that offspring from young parents had a longer larval period than those from old parents. At 25° C. these values were 153.7 and 143.9 days, respectively.

Since there is a lack of information regarding the life cycle of the dark mealworm, *T. obscurus,* it was decided to rear this

* Submitted in partial fulfillment of the requirements for the Ph.D. degree at Fordham University. The author wishes to express appreciation to Dr. Daniel Ludwig, who suggested and directed this investigation.

insect individually at each of three temperatures, 20°, 25° and 30° C. In some experiments both humidity and parental age were controlled. Observations were made on the duration of the various stages of the life cycle, the number of molts and the growth rate in the different environments.

MATERIAL AND METHODS

Adults, collected within 24 hours of emergence, were kept in a specimen dish containing chick growing-mash. When eggs were desired, the beetles were transferred to white flour. Water was supplied by a water bottle plugged with moist cotton. Eggs were collected daily by sifting the flour.

In the first phase of the experiments, the parents were kept at the same temperature as the offspring, 20°, 25° or 30° C. The eggs, as well as the various stages of the life cycle, were maintained in a desiccator, the base of which contained a saturated solution of NaCl (relative humidity 75 per cent). At hatching, larvae were placed individually in 15 ml. vials with a small amount of chick growing-mash. The larvae were examined daily for molts and the exuviae removed. Observations were made on the length of the preoviposition period, the duration of each instar, and of the larval, pupal and adult stages.

TABLE I

Effects of Temperature on the Life Cycle of *T. obscurus.*
(A) at 75 per cent relative humidity
(B) outside the humidifier
Values are given with their standard errors.

	Number of larvae	Duration of egg stage in days	Duration of larval stage in days	Number of larval molts	Duration of pupal stage in days	Duration of adult life in days
20°C.	A. 41	11.56	374.51 ± 20.53	17.29 ± 0.34	13.14 ± 0.22	19.81 ± 1.61
	B. 222	7.02*	204.77 ± 1.67	13.41 ± 0.05	13.05 ± 0.05	31.70 ± 0.94
25°C.	A. 81	6.21	213.40 ± 3.11	16.37 ± 0.11	8.27 ± 0.06	17.37 ± 0.70
	B. 213	6.75	194.06 ± 1.30	15.00 ± 0.05	8.40 ± 0.04	33.91 ± 1.67
30°C.	A. 26	4.00	230.77 ± 4.71	18.46 ± 0.27	6.18 ± 0.12	12.29 ± 0.78
	B. 207	7.01*	218.38 ± 1.74	16.81 ± 0.07	6.29 ± 0.04	14.97 ± 0.44

* Eggs laid and hatched at 25°C

Additional experiments were performed at each temperature. The insects were not kept at 75 per cent relative humidity, but they were kept in vials and the food moistened by adding a drop of tap water several times a week to each vial. In these experiments, eggs were collected from beetles kept at 25° C. and allowed to hatch at this temperature. The larvae, within 24 hours of hatching, were then placed individually in vials and allowed to develop at 20°, 25° or 30° C. In these experiments, parental age was controlled with series being set up at each temperature from parents 7 to 10, 16, 23 and 42 days after emergence. The same observations were made as before; and in addition, the growth rates were determined by weighing 10 insects from each group individually at weekly intervals.

OBSERVATIONS

The preoviposition periods were 9, 6 and 4 days at 20°, 25°

TABLE II

PROBABLE SIGNIFICANCE OF DIFFERENCES FOR THE VARIOUS STAGES AT 20°, 25° AND 30°C., COMPARING THOSE IN THE HUMIDIFIER (A) WITH THOSE OUTSIDE THE HUMIDIFIER (B).

	Difference between means (A) and (B)	Difference/ Standard error of difference* (t value)
Duration of larval stage		
20°C.	169.74 days	8.25
25°	19.34 "	5.76
30°	12.39 "	2.48
Number of larval molts		
20°C.	3.88	11.41
25°	1.37	11.42
30°	1.65	5.89
Duration of pupal stage		
20°C.	0.09 days	0.39
25°	0.13 "	1.86
30°	0.11 "	0.85
Duration of adult life		
20°C.	11.89 days	6.43
25°	16.54 "	8.99
30°	2.68 "	2.98

* Ratios of 2 or more are considered significant.

and 30° C., respectively. At these temperatures and at 75 per cent relative humidity the embryonic periods were 11.56, 6.21 and 4 days, respectively (table I).

As shown in the table, the larval period and the number of larval molts were greater for insects reared at 75 per cent rela-

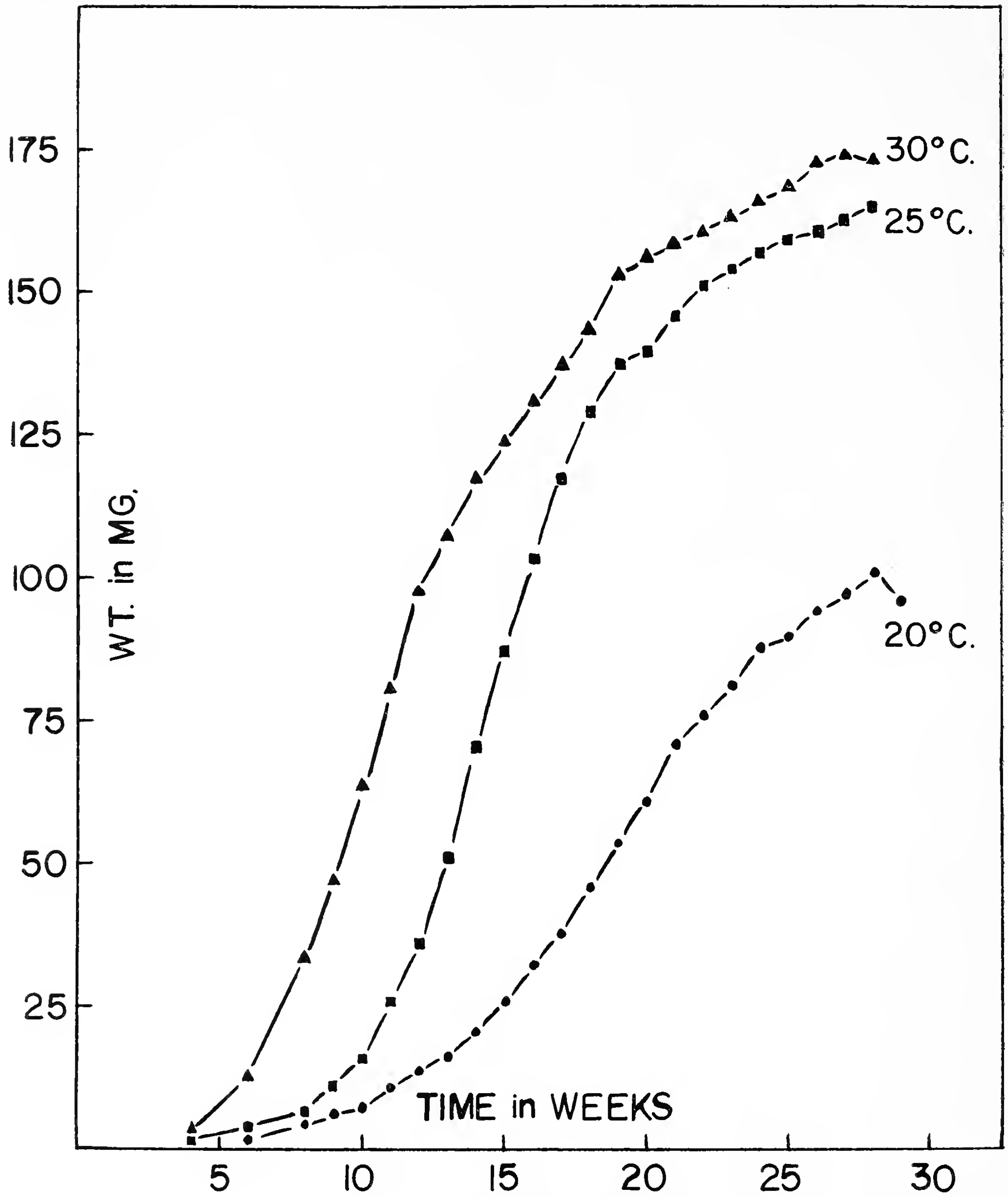


FIG. 1. Growth rate of larvae of *T. obscurus* at 20°, 25° and 30°C.

tive humidity than for those kept outside of the humidifier. Furthermore, the duration of adult life was considerably reduced for those kept in the humidifier. At each temperature the pupal period was the same in the two series. The optimal

temperature was 25° C., the larval period being shortest at this temperature. A temperature of 30° C. greatly reduced adult longevity. Pupal life was shorter, the higher the temperature.

The range in the number of larval molts was smallest at 25° C., being 13 to 19. The corresponding values at 20° and 30° C. were 12 to 22 and 15 to 24, respectively. The average number of molts was greater at the higher temperatures, being 14.01, 15.38 and 16.99 at 20°, 25° and 30° C., respectively. At each temperature the dark brown color characteristic of the mature larva was attained about the eighth instar.

TABLE III

EFFECT OF PARENTAL AGE ON THE LIFE CYCLE OF *T. obscurus* REARED OUTSIDE THE HUMIDIFIER. VALUES ARE GIVEN WITH THEIR STANDARD ERRORS.

Age of parents in days after emergence	Number of larvae	Duration of egg stage in days	Duration of larval stage in days	Number larval molts	Duration of pupal stage in days	Duration of adult life in days
20°C. 7–10	65	7.00*	204.85 ± 3.28	13.48 ± 0.08	12.83 ± 0.09	30.13 ± 1.34
16	54	7.00*	200.74 ± 2.68	13.19 ± 0.10	13.22 ± 0.08	33.04 ± 1.00
23	55	7.00*	210.82 ± 3.35	13.31 ± 0.10	13.42 ± 0.10	31.27 ± 1.93
42	48	7.10*	202.29 ± 3.83	13.69 ± 0.12	12.70 ± 0.08	32.87 ± 3.09
25°C. 7–9	60	7.00	196.67 ± 2.10	14.95 ± 0.09	8.38 ± 0.07	40.10 ± 3.59
16	52	7.00	191.54 ± 2.88	14.85 ± 0.10	8.37 ± 0.07	30.41 ± 3.17
23	56	6.00	190.89 ± 2.36	14.75 ± 0.10	8.25 ± 0.07	35.26 ± 2.69
42	45	7.07	197.44 ± 3.09	15.53 ± 0.10	8.67 ± 0.10	27.25 ± 2.67
30°C. 9	58	7.00*	210.52 ± 3.12	16.17 ± 0.11	6.20 ± 0.07	14.50 ± 0.65
16	54	7.00*	222.96 ± 3.69	16.94 ± 0.10	6.33 ± 0.07	15.00 ± 0.84
23	51	7.00*	218.92 ± 3.51	16.84 ± 0.10	6.35 ± 0.07	15.84 ± 0.92
42	44	7.07*	222.50 ± 3.24	17.43 ± 0.14	6.29 ± 0.08	14.50 ± 0.10

* Eggs laid and hatched at 25°C.

When those reared in the humidifier were compared with the others, significant differences were obtained for the duration of the larval life, the number of larval molts and the duration of adult life at each temperature (table II). No significant difference was found in the duration of the pupal stage at any of the temperatures.

Figure 1 shows the rate of larval growth at temperatures of 20°, 25° and 30° C. Growth was more rapid the higher the temperature. The average maximal larval weights were also higher at the higher temperatures, being approximately 175, 165 and 100 mg. at 30°, 25° and 20° C., respectively.

The effects of parental age on the life cycle are shown in table III. Parental age did not have any consistent effects on

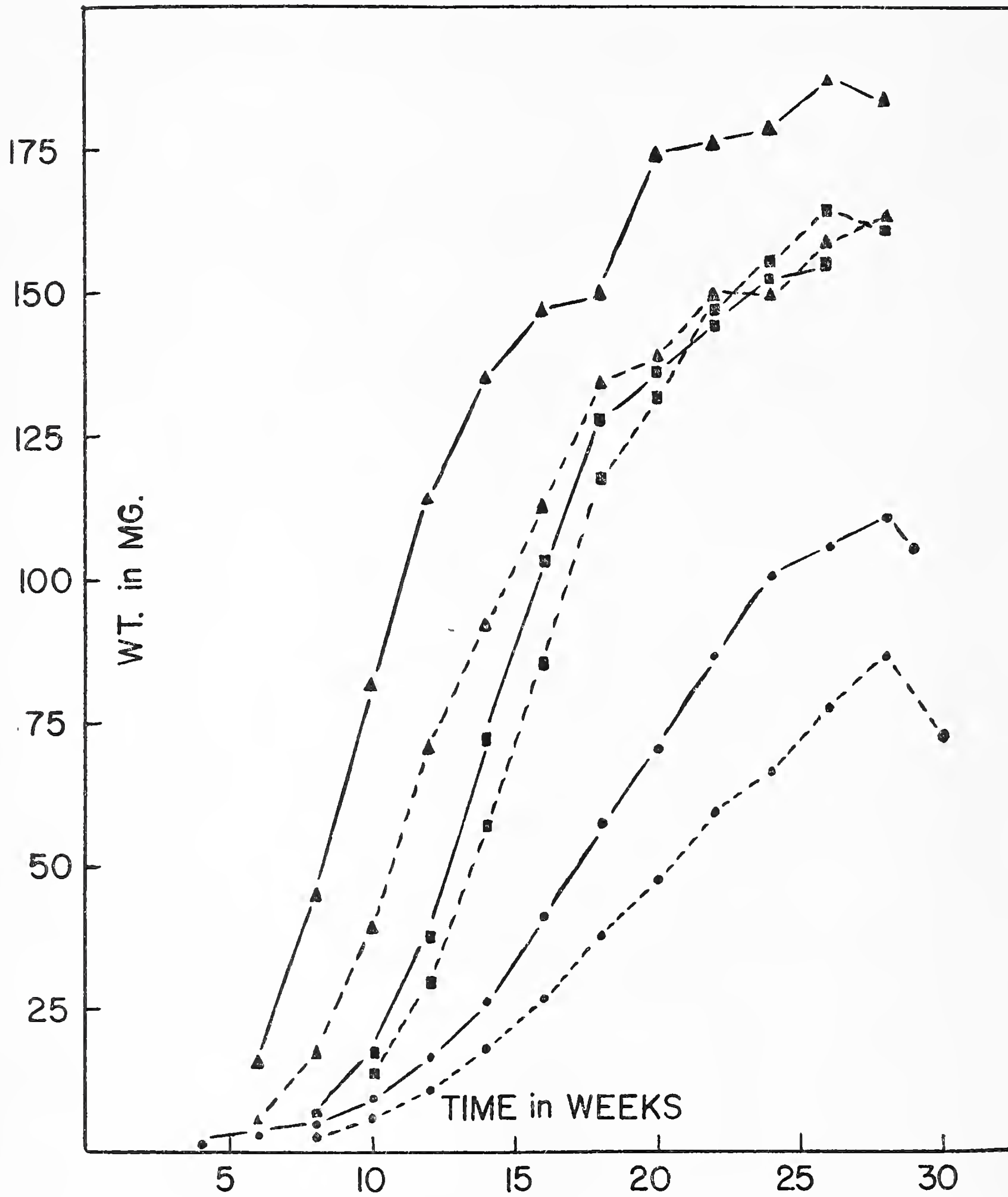


FIG. 2. Effect of parental age on the growth of *T. obscurus* larvae. Circles, larvae at 20°; squares, larvae at 25°; triangles, larvae at 30°C. Solid lines, larvae from parents 7–10 days after emergence; broken lines, larvae from parents 42 days after emergence.

the duration of the life cycle. Parental age, however, did affect the growth rate of the larvae at each temperature. As figure 2 shows, larvae from old parents had a slower rate of growth than those from young parents and, except at 25° C., failed to attain the same maximal weight.

DISCUSSION

In the present experiment, a temperature of 25° C. shortened the duration of the larval stage as compared with that obtained at either 20° or 30° C. It was observed that a few individuals in each group at 30° C. did not pupate properly, being unable to shed the last larval exuviae. Hence, the present experiments are in agreement with those of Arendsen Hein (1923), who found that the optimal temperature for *T. obscurus* is between 25° to 27.5° C. while at 30° C. there was a delayed metamorphosis and an increased larval mortality.

The long larval life in the humidifier may have been due to a diapause which occurred in some individuals, lack of direct water feeding or an inadequate oxygen supply. The humidifiers were opened only once a day so that there was probably an oxygen deficiency, especially for large larvae and adults. Unpublished work in this laboratory on *T. molitor* shows that adding water to the food may hasten growth.

The increase in the number of larval molts obtained at the higher temperatures agrees with the work of Ludwig (1956), who found that the yellow mealworm, *T. molitor,* had more molts at 30° C. than 25° C., the averages being 19.1 and 13.2, respectively. Cotton (1927) observed that *T. obscurus* molted 12 to 22 times, with about half of the larvae molting 14 or 15 times. However, he did not show any temperature effects on molting.

The greater maximal larval weights obtained at higher temperatures agree with the results of Ludwig (1932 and 1939), who found that in the Japanese beetle, *Popillia japonica,* the average weight of the full grown larvae was less at 20° than at 25° C. These results are contrary to the general rule enunciated by Titschack (1925), that insects reared at low temperatures grow to a larger size than those reared at higher temperatures.

Ludwig (1956) and Tracey (1958) showed that larvae of *T. molitor* obtained from old parents had a shorter larval life.

This effect was not found with *T. obscurus.* Tracey (1958) also found that the growth rate was faster in offspring from old parents than in those from young parents. In the present work, parental age affected the offspring in that those from old parents were delayed in their growth rate.

SUMMARY

At each temperature, 20°, 25° and 30° C., the life cycle of the dark mealworm, *Tenebrio obscurus,* was longer when the insect was reared in the humidifier at 75 per cent relative humidity than when it was reared outside the humidifier. This effect may be due to an oxygen deficiency in the humidifier.

Larval life was shortest at 25° C., being 194.06 days outside the humidifier as compared to corresponding figures of 204.77 and 218.38 days at 20° and 30° C., respectively.

The range obtained for the number of larval molts was smallest at 25° C., being 13 to 19 as compared to 12 to 22 and 15 to 24 at 20° and 30° C., respectively.

The duration of adult life was considerably shorter at 30° than at either 20° or 25° C. Outside the humidifier, adults at 30° C. lived less than half as long as those at the other two temperatures.

The rate of larval growth increased with a rise in temperature. Maximal larval weights were also higher at the higher temperatures, being approximately 175, 165 and 100 mg. at 30°, 25° and 20° C., respectively.

Parental age did not have any consistent effects on the duration of the life cycle. However, larvae from old parents had a slower rate of growth than those from young parents.

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NOTES ON ARADIDAE IN THE U.S. NATIONAL MUSEUM (HEMIPTERA) II.

BY NICHOLAS A. KORMILEV
BROOKLYN, N. Y.

II. Subfamily CARVENTINAE.*

I wish to express once more my thanks to Dr. Carl J. Drake and Dr. Reece I. Sailer, through whose good offices I had the privilege to study the unidentified Aradidae in the collections of the U. S. National Museum in Washington, D. C., including the Drake Collection.

CARVENTUS Stal, 1865.

The genus *Carventus* Stal, 1865, is circumtropical. Its 21 species live mostly in the humid tropical forests. The bulk of the species belong to the Oriental and Ethopian Regions; others penetrated to Madagascar and new Guinea. One was found in Samoa, one in Central America, and one, recently, was described from the Australian mainland. From the latter, *Carventus australis* Kormilev, 1958, were known only females, now I have an opportunity to give a brief description of the male.

1. *Carventus australis* Kormilev, 1958

Carventus australis Kormilev, 1958 Jour. N. Y. Ent. Soc. **66**: 87, figs. 1–2.

MALE. Similar to the female, but smaller. Lobes of sternum VIII are small, conical, apically rounded; hypopygium elongately cordiform.

BIOMETRICAL MEASURES: head 18: 20 (in this and the following descriptions the first figure is always the length, and the second the width); antennae (1 to 4) 10: 6: 10: 8; pronotum 25: 32.5 (across the fore lobe), or 41 (across the humeri); scutellum 14: 23; abdomen 63: 52 (across segment IV).

MALE, total length 4.0 mm.; width of the pronotum 1.33 mm.; width of the abdomen 1.73.

ALLOTYPE: Male, Queensland, Australia—H. Hacker coll.; deposited in the U. S. National Museum, Washington, D. C., "Drake Collection."

* See: Kormilev, N. A. Notes on Aradidae in the U.S.N.M. (Hem.) I. Subfam. Calisiinae; Proc. U.S.N.M. **109**, No. 3413 pp., 209–222. (1958).

GLYPTOCORIS Harris & Drake, 1944.

Usinger & Matsuda, listing the species of the genus *Glyptocoris* Harris & Drake, 1944, put a question mark beside the species *G. verus* Drake, 1956 (1959:125). At the time I made the key for the *Glyptocoris* species, I could not examine this species, so it was omitted from the key (N. A. Kormilev, Notes on Neotropical Aradidae IX; Studia Entomologica, II: 309–320). Later, Dr. J. C. Drake, kindly loaned me a paratype. It is a *Glyptocoris,* though systematically it stays a little apart from other species in the genus. Wygodzinsky (1948:6) separated all species of *Glyptocoris* into two groups: with the spiracles of the anterior abdominal segments ventral, placed near the lateral margin; and in those placed on the lateral margin and visible from above. In *G. verus* the spiracles of the first three segments are ventral, placed far from the lateral margin; those of the segments V and VI sublateral but visible from above, as those of VII and VIII which are lateral.

Glyptocoris verus Drake is rather flat, the lateral borders of the pronotum bear two tubercles set apart, the anterior is small, the posterior is bigger; mesonotum has also two tubercles, but almost fused together, the anterior is very small, the posterior bigger, but not so big as that of the pronotum; metanotum is almost straight, only posteriorly with a very small tubercle.

III. Subfamily MEZIRINAE.

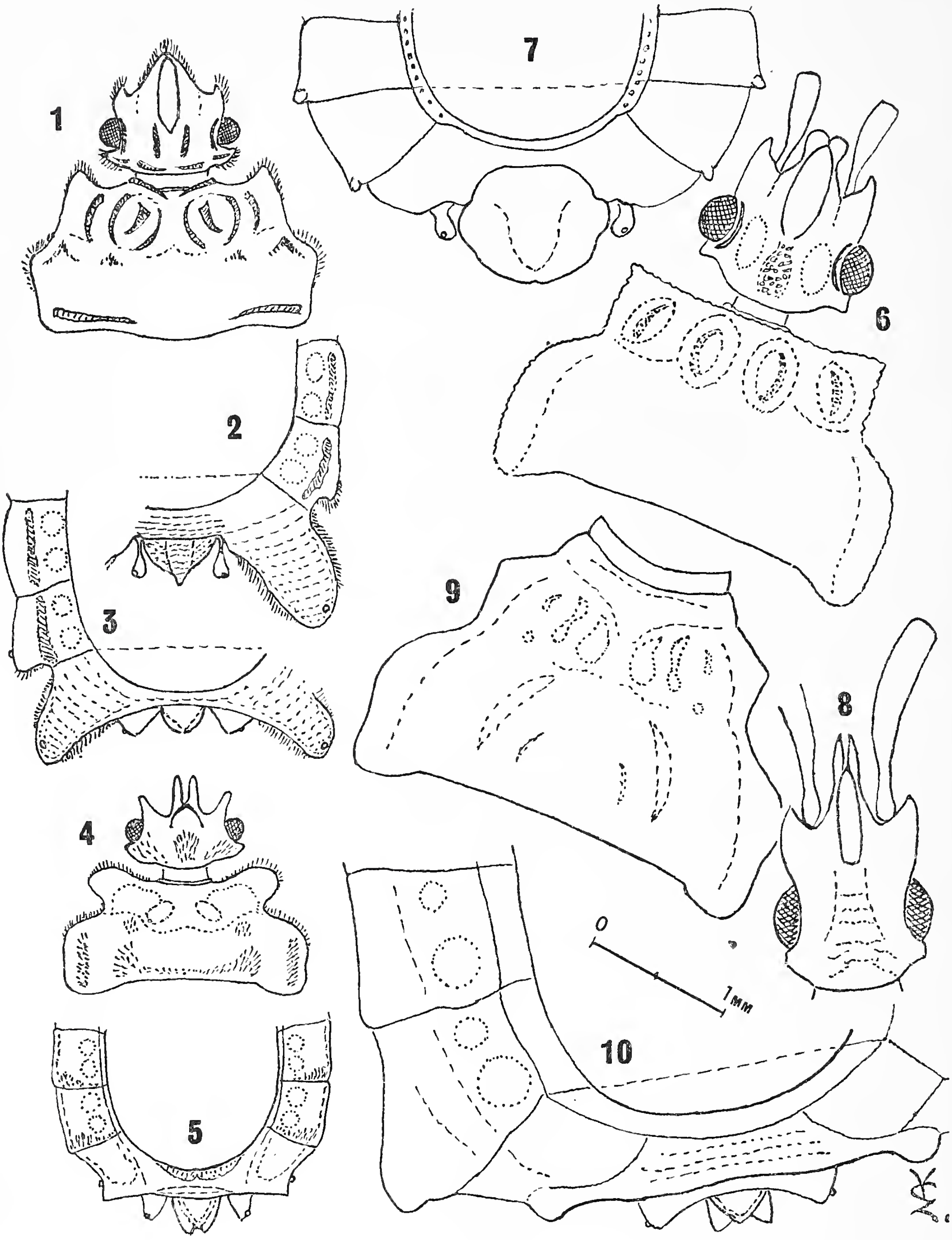
NOTAPICTINUS Usinger & Matsuda, 1959.

1. **Notapictinus parvulus** new species

MALE. Small, elongately ovate, slightly widening backward, brachypterous.

HEAD. Slightly shorter than wide through the eyes (27:31). Anterior process moderately robust, anteriorly deeply notched, jugae being much longer than tylus, exteriorly rounded and granulate, reaching to 2/3 of the first antennal segment. Antenniferous tubercules stout, broad, rounded, reaching to 1/3 of the first antennal segment. Eyes relatively big, semiglobose. Postocular tubercules small, do not reach the outer margin of the eyes. Lateral shelves with two (1 + 1) ovate callous spots. Antennae short, less than twice as long as the head; the proportions of the antennal segments (1 to 4) are: 12: 7: 12: 12. Rostral groove broad and shallow, open posteriorly; rostrum reaches the base of the head. The head is granulate and with short, erect bristles.

PRONOTUM. Sharply divided into two lobes, much shorter than wide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across the humery (28: 54); fore lobe is narrower than the hind lobe (43: 54); Collum narrow but distinct; antero-lateral angles obliquely truncate, and angularly produced sideways; lateral notch sharp, angular; fore disc with two (1+1) low, somewhat obliterated, callosities; hind disc roughly granulated; lateral borders of the hind disc straight, anteriorly flattened and produced into subangular lobes; hind border slightly convex in the middle.

SCUTELLUM. Half as long as wide at the base (15: 30); lateral borders slightly convex and rimmed; apex rounded; disc moderately inflated and granulated, with a fine median ridge, marked only by a row of granulae,

HEMELYTRA. Reduced to wide, rounded pads, laterally roundly produced beyond the outer border of the mesonotum, and slightly reflexed, posteriorly do not reach the middle of the scutellum. Membrane is completely lacking, but clavus is discernible, separated from the corium by a suture.

ABDOMEN. Much longer than wide (90: 67), with the whole tergum exposed. Tergum I is visibly separated from the metanotum and CDP (Central dorsal plate); CDP formed by tergum II to VI, fused together, flat, slightly concave and punctured; the limits between segments marked by very fine, transverse carinae; along the lateral border of CDP runs a carina bearing a row of long, erect bristles. First and second scent gland openings are distinct; callous spots are rather obsolete. Midlateral glabrous areas completely fused with the tergum. Tergum VII separated from CDP by a very fine, but distinct sulcus; disc is anteriorly granulate, posteriorly transversely rugose; laterally with a row of erect bristles. Connexivum broad, granulate, and with dispersed short, curled hairs; PE-angles (postero-exterior) of connexivum VII slightly angularly produced. Lobes of the VIII (male) short, rounded, with a lateral spiracle. Hypopygium moderate in size, posteriorly rounded, with a broad elevated median ridge. Spiracles of sternum II sublateral, placed on the high tubercles, and visible from

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EXPLANATION OF PLATE

FIG. 1. **Forficulassa lobulata** n. g., n. sp., male, the head and pronotum.

FIG. 2. **Forficulassa lobulata** n. g., n. sp., male, postero-lateral part of the abdomen.

FIG. 3. **Forficulassa lobulata** n. g., n. sp., female, postero-lateral part of the abdomen.

FIG. 4. **Chapadia alata** n. g., n. sp., female, the head and pronotum.

FIG. 5. **Chapadia alata** n. g., n. sp., female, posterior part of the abdomen.

FIG. 6. **Santaremia robusta** n. g., n. sp., male, the head and pronotum.

FIG. 7. **Santaremia robusta** n. g., n. sp., male, posterior part of the abdomen.

FIG. 8. **Parahesus truncatus** n. g., n. sp., female, the head.

FIG. 9. **Parahesus truncatus** n. g., n. sp., female, the pronotum.

FIG. 10. **Parahesus truncatus** n. g., n. sp., female, postero-lateral part of the abdomen.

above; those of III to V ventral, remote from the margin; those of VI sublateral, VII and VIII lateral, and visible from above.

Color. Ferrugineous; tergum lighter, reddish brown; antero-lateral angles of connexiva on the dorsal and ventral side, abdominal scent gland openings, rostrum and tarsi, yellow or yellow brown.

Male. Total length 2.76 mm.; width of the pronotum .9 mm.; width of the abdomen 1.12 mm.

Holotype: Male. Barro Colorado Is., Panama, CZ—Zetek coll. VIII–IX, '49; deposited in the U. S. N. M. (No. 64819).

Usinger & Matsuda recently have split the genus *Pictinus* Stal, 1873, into five separate genera, leaving in *Pictinus* only american species with the stridulatory mechanism. For the rest of american macropterous species, previously referred to this genus, they created a new genus named *Notapictinus* Usinger & Matsuda, 1959. Besides the five species referred by them to the genus *Notapictinus* (1959:362), to the genus belong also the following species: *Pictinus martinezi* Kormilev, 1953, *Pictinus beckeri* Kormilev, 1959, *Pictinus nanus* Kormilev, 1959, *Pictinus sanmigueli* Kormilev, 1959, *Pictinus luteoincrustatus* Kormilev, 1959, *Pictinus derivatus* Kormilev, 1959, *Pictinus maculatus* Kormilev, 1959, *Pictinus rutilus* Kormilev, 1959, and from brachypterous, *Pictinus brachypterus* Drake & Kormilev, 1958.

To the true *Pictinus,* besides four species listed by Usinger & Matsuda (1959:360), belong also the following species: *Pictinus fronto* Bergroth, 1894, *Pictinus stali* Kormilev, 1959, *Pictinus pilosulus* Kormilev, 1959, *Pictinus wittmeri* Kormilev, 1959, and *Pictinus fictus* Kormilev, 1959.

FORFICULASSA new genus

By connexivum VII in the males produced backward as big lobes, this genus resembles vaguely *Psorosoma* Champion, 1898, but belongs to the subfamily Mezirinae, and should be placed near *Banksiessa* Usinger & Matsuda, 1959. The head, and particularly the pronotum, are rather similar to this genus.

Head. As long as wide through the eyes; anterior process robust, conical, jugae convergent, slightly surpassing the tylus, reaching to ¼ of the first antennal segment; antenniferous tubercules dentiform, curved inside, their tips parallel between themselves, slightly surpassing the base of the first antennal segment. Eyes small, exerted, almost globular. Postocular tubercles dentiform, directed slightly backward, do not reach the outer border of the eyes. The upper surface of the head, particularly the anterior process,

antenniferous and postocular tubercules, and vertex, are partly covered with incrustated curved hairs, sometimes glued together and forming keels or carenae. Similar carenae of glued hairs are also present on the pronotum, scutellum and connexivum. On the vertex they form two parallel, longitudinal carinae. Antennae long, more than twice as long as the head; the first segment clavate, the 2d and 3d slightly tapering to the base, the 4th fusiform; the first is the longest, the 2d half as long as the first, the third shorter than the first, but longer than the 2d, the 4th half as long as the 3d. Rostral groove is narrow, posteriorly closed; rostrum reaching to the posterior border of the latter.

PRONOTUM. Much shorter than wide across the humeri, divided into two lobes. Collum carinate, with erect glued hairs. Antero-lateral angles angularly produced, obliquely raised, and directed forward, covered with incrustated bristles. Fore disc with two (1 + 1) ovate callosities, each with an erect, oblique carina, formed by glued hairs, and with a fringe of similar hairs around them. Similar carinae of glued hairs are also on the hind disc laterally, and along the hind border. The head and pronotum are without granulation. Lateral notch is concealed by the incrustated hairs. Hind disc inflated; its lateral borders parallel between themselves, converging anteriorly; hind border slightly convex.

SCUTELLUM. Triangular, shorter than wide at the base; disc inflated, transversely rugose; lateral borders straight, carinate; median ridge with incrustated hairs.

HEMELYTRA. Reach to the hind border of tergum VII; baso-lateral borders of the corium reflexed, forming high carinae; apical border angularly cut out; apical angle produced backward beyond the base of connexivum II (the first visible). Membrane big, opaque, with anastomosed veins.

ABDOMEN. Much longer than wide; lateral borders subparallel between themselves, slightly convex; exterior borders of the connexiva each slightly convex, those of connexivum VI produced as small, rounded, subtriangular lobes; connexivum VII in the males form two (1 + 1) big, flat, posteriorly rounded lobes, produced far beyond the tip of the hypopygium, giving to the insect a curious forficuloid look. In the females these lobes are much shorter, but still produced behind the tip of segment IX. Tergum is densely punctured; laterally and on the median line smooth. Midlateral glabrous areas completely fused with the tergum. Connexivum is broad; along the outer border of connexiva runs an erect carina formed by incrustated hairs glued together. Similar carina, but lower is on the ventral side of connexivum. Hypopygium is relatively small, conical; lobes of VIII small, rounded, do not reach the tip of the hypopygium. Sternum VI in the females roundly cut out for the reception of the genital plates. Sternum III through V with a straight, slightly inflated posterior border in both sexes. Spiracles II through V ventral; those of VI lateral and visible from above; those of VII dorsal, placed near lateral margin of the lobes; those of VIII lateral and visible from above.

LEGS. Inermes, but with dense incrustated bristles on the femora and tibiae. Metathoracal scent gland openings triangular, placed outside of median acetabulae.

Type species: **Forficulassa lobulata** n. sp.

The big, rounded lobes of connexivum VII with the spiracles placed on the dorsal side, separate this genus from all other american Mezirinae.

1. **Forficulassa lobulata** n. sp.

Figs. 1–3

Male. Head, pronotum, with exception of the hind border, antennae, and legs, are brown; the rest of the body reddish brown; rostrum, tarsi, the big round spots on the connexivum (dorsal and ventral side), and the smooth median line and borders of the tergum, are yellow or dirty yellow.

Biometrical measures. Head (male—27: 27, female—27: 28); antennae male—30: 14: —:—; female—25: 15: 20: 10, the last two segments in the male are lacking); pronotum (male—30: 41 across the fore lobe, or 55 across the humeri; female—32: 42 and 56 respectively); scutellum (male—20: 30; female—21: 30); abdomen (male—88 to the tip of the hypopygium, or 100 to the tip of the lobes: 67 across segment IV; female—90 or 95 respectively: 73 across segment IV).

Total length. Male—6.0, female—5.9 mm; width of the pronotum: male—1.83, female—1.87 mm.; width of the abdomen: male—2.23, female—2.83 mm.

Holotype: male, Para, Brazil—P. R. Uhler coll.; deposited in the U. S. National Museum (No. 64820).

Allotype: female, Santarem, Brazil—Acc. No. 2966; deposited in the U.S.N.M., Drake collection.

CHAPADIA new genus

Small, elongately ovate, slightly widening backward.

Head. Shorter than wide through the eyes; anterior process wide and long, anteriorly deeply notched; jugae dentiform, parallel between themselves, anteriorly rounded, produced far beyond the tip of the tylus, reaching to the middle of the first antennal segment; antenniferous tubercles flat, rounded, their flat side strongly inclined, almost vertical. Antennae almost twice as long as the head; the first segment clavate, the 2d and 3d slightly tapering toward the base, the 4th fusiform; the third the longest, the second the shortest. Eyes moderate in size, exerted, semiglobose. Postocular tubercles dentiform, slightly projecting beyond the outer border of the eyes; posterior border of the head widely rounded; vertex covered with erect incrustated bristles. Rostral groove moderately wide, shallow, posteriorly closed; rostrum short, does not reach the hind border of the groove.

Pronotum. Half as long on the median line as wide across the humeri; collum fine, granulate; anterior border feebly cut out; antero-lateral angles produced laterad as big, rounded, slightly reflexed lobes; fore disc with two (1 + 1) rather obsolete, callous spots; lateral, interlobal, notch very deep, rounded; lateral borders of the hind lobe parallel between themselves,

anteriorly convergent; posterior border almost straight in the middle, slightly roundly produced laterally. Hind disc wider and higher than the fore disc, covered with irregularly dispersed erect, incrustated bristles.

SCUTELLUM. Subtriangular, shorter than wide at the base, apically rounded; basal and lateral borders finely rimmed; disc sharply, transversely rugose, near the base with two (1 + 1) transversely ovate, depressed, callous spots; median ridge thin and covered with high, erect, incrustated bristles.

HEMELYTRA. Reach (female) to 2/3 of tergum VII. Corium reaches beyond the base of connexivum III (the second visible), its basolateral border reflexed, slightly divergent backward; apical border angularly cut out interiorly; apical angle acute. Membrane big, opaque, almost without veins, only at the base with a few, irregularly curved veins.

ABDOMEN. Ovate; lateral borders slightly convex, rounded; PE-angles of connexiva II through V not produced; those of VI slightly produced; those of VII with a small, triangular, apically rounded lobe, directed back and sidewalks. Midlateral glabrous areas clearly visible, narrow, less than 1/3 as wide as connexivum, and separated from the tergum by a row of erect bristles; tergum VII (female) posteriorly raised and covered with dense, incrustated, erect bristles. Connexivum rather wide, posterior borders of connexiva with erect incrustated bristles. Spiracles placed on the tubercles; II through VI ventral, placed far from the outer border, but progressively approaching it, not visible from above; those of VII and VIII lateral and visible from above. Genital lobes (VIII) relatively big, triangular, almost reaching the tip of IX; IX notched on the tip, gential valves being longer than the oviduct. Metathoracal scent gland openings narrow, placed lateral and somewhat behind the median acetabulae. Posterior borders of sterna slightly elevated; this of sternum VI roundly cut out. Genital and subgenital plates, and genital lobes on the ventral side, covered with erect, incrustated bristles.

LEGS. Inermes; fore tibiae with a small subapical "comb" on the inner side.

Type species: **Chapadia alata** n. sp.

Chapadia n. g. belongs to "Phyllotingis group" of genera, with long jugae produced far beyond the tip of the tylus. It is mostly allied to *Placogenys* Usinger & Matsuda, 1959, differing from it by: deeply notched lateral sides of the pronotum, and erect, incrustated bristles on various parts of the body.

In 1955 I described a new genus, based on a new species from Peru, which was named *Diphyllonotus*. The manuscript was sent to Revista Ecuatoriana de Entomologia y Parasitologia. But the volume III, in which it was supposed to be printed, never appeared. In 1956 I published the second species of the genus named *Diphyllonotus brachypterus* Kormilev, 1956, but

the genus was not validated. In 1958, losing all hopes that my MS will be published, and not able to get it back, I redescribed the genus and sent it to the Proceedings of the Entomological Society of Washington, where it was published in vol. 61, p. 61. But in the meantime Usinger & Matsuda published this genus under the name of *Placogenys,* so we have now a new synonymy: *Placogenys brachypterus* (Kormilev), 1956, and *Placogenys explanatus* (Kormilev), 1959.

1. **Chapadia alata** n. sp.

Figs. 4–5.

FEMALE. Uniformly yellow brown; rostrum yellow; membrane reddish brown, at the base whitish.

BIOMETRICAL MEASURES. Head (19:23); antennae (10:7:11:9); pronotum (21:37, across the fore lobe, or 47, across the hind lobe); scutellum (17:24); abdomen 69:57, across segment V).

FEMALE. Total length 4.3 mm.; width of the pronotum 1.56 mm.; width of the abdomen 1.9 mm.

HOLOTYPE: female, Chapada, Brazil; deposited in the U. S. National Museum, Washington, D. C., U. S. A. (No. 64821).

SANTAREMIA n. g.

Elongately ovate, rather robust.

HEAD. Slightly shorter than wide through the eyes; anterior process robust with subparallel lateral borders, anteriorly slightly notched, reaches to the middle of the first antennal segment; antenniferous tubercles dentiform, their outer borders parallel between themselves, exteriorly slightly convex. Antennae moderately robust, twice as long as the head; the first and 3d segment subequal in length, the 2d shorter, the 4th the shortest. Eyes big, exerted, semiglobose. Postocular tubercles small, dentiform, do not reach the outer border of the eyes; vertex with short curled hairs; lateral shelves with ovate, smooth callosities. Rostral groove wide and deep, posteriorly open; rostrum slender, does not reach the hind border of the groove.

PRONOTUM. Shorter than wide across the humeri; sharply separated into two lobes by a very deep transverse sulcus; collum tiny, but sharply separated from the fore lobe; anterior border of the fore lobe slightly cut out; antero-lateral angles rectangular; lateral borders of the fore lobe parallel between themselves; the fore disc with a deep median sulcus; laterad of it with two (1+1) high, granulate tubercules, and farther to the lateral borders, with two (1+1) longitudinal, granulate ridges. Hind lobe is higher and wider than the fore lobe; hind disc with rough, setigerous granulation; lateral borders parallel between themselves, anteriorly convergent; hind border straight, laterally with two (1+1) very small, rounded lobes; directed backward.

SCUTELLUM. Subtriangular; basal and lateral borders rimmed; apex cut out; disc moderately inflated, transversely rugose; median ridge granulate.

HEMELYTRA. Reach to 2/3 of tergum VII (male); basolateral border of corium slightly reflexed, but not projected outside of the pronotum; apical border of the corium slightly cut out exteriorly, then convex, rounded; near the inner angle again roundly cut out. Veins of the corium with setigerous granulation, make a big loop. Membrane with anastomosed veins.

ABDOMEN. With feebly undulate sides, slightly shorter than wide, widening backward. Midlateral glabrous areas completely fused with the tergum. Connexivum II (the first visible) with the hind border strongly elevated in a form of a ridge; PE–angles of connexiva III and IV barely protruding; those of V sharply pointed and reflexed; posterior borders of connexiva V and VI slightly carinate. Tergum VII (male) is raised almost vertically in the first ¾ of the disc, forming a semicircular plate, separated from the hind ¼ of the disc by a carinate border. Hypopygium is very big, semiglobose, with a stout median ridge tapering backward. Genital lobes very small and short, obliquely truncate. Spiracles II through VII ventral, placed far from the outer border; those of VIII lateral and visible from above. Sterna III through V with a straight, inflate and smooth posterior border; anteriorly deeply punctured. Sternum VI widely cut out; sternum VII rugose and with a depressed tubercle in the middle of the disc.

Metathoracal scent gland openings narrow, placed laterad and behind the median acetabulae. Propleurae granulate; meso- and metapleurae sharply rugose. Legs inermes; but femora inflated, fusiform, with sharp granulation, and erect bristles on inside. Tarsi without arolia.

Type species: **Santaremia robusta** n. sp.

The new genus is allied to the genus *Aphleboderrhis* Stal, 1860, but differs from it by: membrane with anastomosed veins; midlateral glabrous areas completely fused with the tergum; the shape of pronotum, with rectangular antero-lateral angles; high transverse ridge on the hind border of connexivum II.

1. **Santaremia robusta** n. sp.

Figs. 6–7.

MALE. Ferrugineous; membrane brown, at the base whitish; tarsi and the 4th antennal segment on the apical half are yellow brown.

BIOMETRICAL MEASURES Head (22:24); antennae (13:10:14:8); pronotum (26:37, across the fore lobe, or 50, across the hind lobe); scutellum (20:27); abdomen (60:62).

MALE. Total length 6.6 mm.; width of the pronotum 2.5 mm.; width of the abdomen 3.1 mm.

Holotype: Male, Santarem, Brazil—Acc. No. 2966; deposited

in the U. S. National Museum, Washington, D. C. (No. 64822).

Paratype: Male, collected with the holotype; deposited in the collection of the author.

PARAHESUS n. g.

Elongately triangular, posteriorly truncate; head, pronotum and scutellum more, hemelytra and abdomen less, covered with short, curled, incrustated, yellow hairs; antennae and legs, with finer and less incrustated bristles. Head and pronotum with very fine, whitish incrustation.

HEAD. Much longer than wide through the eyes; anterior process porrect, bifide; jugae dentiform, much longer than the tylus, reach 2/5 of the first antennal segment. Antenniferous tubercles dentiform, slightly divaricating; eyes elongately ovate, slightly flattened from the sides; postocular tubercles rounded, not reaching the outer border of the eyes. Infraocular carinae lacking; vertex roughly, transversely rugose. Antennae long, moderately stout, more than twice as long as the head; the first segment long, clavate; the 2d and 3d subcylindrical, slightly tapering toward the base; the 4th elongately pyriform; the first and the 3d subequal in length; the 2d and 4th also, but much shorter than the first two. Rostral groove long, with parallel borders, rather deep, transversely rugose, posteriorly open, reaching to the hind border of the head; rostrum moderately stout, does not reach the hind border of the groove.

PRONOTUM. Subtrapezoidal, shorter than wide across the humeri; collum anteriorly cut out, occupies almost the whole anterior border of the pronotum; it is separated from the fore lobe by a deep, arcuate furrow; lateral borders of the fore lobe obtusely angulate, and reflexed; fore disc with six (3 + 3) longitudinal, narrow, curved, callous spots. Interlobal transverse depression is deep. Lateral borders of the hind lobe parallel between themselves, anteriorly converging; humeri slightly elevated; hind border straight, laterally protruding backward as short, rounded lobes.

SCUTELLUM. Subtriangular, shorter than wide at the base; all borders rimmed; disc inflated in the middle, roughly, transversely rugose, similar as in the genus *Miorrhynchus* Champion, 1898.

HEMELYTRA. Reaching to the middle of tergum VII (female); corium slightly produced beyond the base of connexivum II (the first visible); its baso-lateral border slightly cut out and reflexed; apical border angularly cut out; apical angle acute; veins covered with curled, incrustated hairs; membrane opaque, with anastomosed veins.

ABDOMEN (FEMALE). Longer than wide across segment VI, posteriorly truncate, so that connexiva VII are between, not behind, connexiva VI; lateral borders firstly convex, then slightly cut out; connexivum VI makes an almost right angle, apically rounded. Connexivum VII with two (1 + 1) small, rounded, and slightly reflexed, lobes. PE–angles rounded, slightly prominent. Genital segments similar to *Miorrhynchus*, only the lobes of VIII are relatively shorter, and segment IX also. Midlateral glabrous areas fused with the tergum. Sternites III through V with straight hind borders; sternum VI three times roundly cut out; in the middle deeper,

for reception of genital plates, laterally shallower. Spiracles from II to VII ventral, as in *Hesus* Stal, 1862; those of VIII lateral and visible from above.

Metathoracic scent gland openings placed laterad and a little behind the median acetabulae. Legs long, inermes.

Type species: **Parahesus truncatus** n. sp.

Parahesus n. g. at first sight looks like a big *Miorrhynchus*, with abdomen truncate posteriorly; in the key of Usinger & Matsuda, it runs to *Helenus* Buchanan White, 1879; its head and antennae are similar to those in *Hesus* Stal, but it cannot be placed in any one of these genera. From *Miorrhynchus* and *Helenus* it differs by much broader, and posteriorly truncate, abdomen; and position of the spiracles, which are all, but those of VIII, ventral, and not visible from above; from *Hesus* it differs by curled, incrustated hairs, subtriangular, posteriorly truncate, body, and by the position of the spiracles.

1. **Parahesus truncatus** n. sp.
Figs. 8–10.

FEMALE. Yellow brown to reddish brown, but the whitish incrustation on the head and pronotum makes them greyish brown. Antennae, with exception of the apical half of segment IV, femora, tibiae, with exception of an antebasal yellow ring, and the outer borders of connexiva, with exception of PE-angles and a few spots on the lateral carina of the tergum, are piceous or black. Eyes, rostrum, tarsi, and round callous spots on the connexivum, are yellow or pale yellow brown.

BIOMETRICAL MEASURES.... Head (33:21); antennae (27:14:26:15); pronotum (38:37, across the fore lobe, or 57, across the humeri); scutellum (23:32); abdomen (100:91, across segment VI).

FEMALE. Total length 9.85 mm.; width of the pronotum 2.85 mm.; width of the abdomen 4.55 mm.

Holotype: Female, Tumupasa, Bolivia—M. R. Lopez coll. Dec.; Mulford—Bio Exp., 1921–22. The holotype bears a label "Cinyphus det. H. G. Barber." Deposited in the U. S. National Museum, Washington, D. C. (No. 64823).

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USINGER, R. L. AND R. MATSUDA. 1959. Classification of the Aradidae (Hemiptera-Heteroptera); London, vii–410, 102 figs.

WYGODZINSKY, P. Studies on some apterous Aradidae from Brazil (Hemiptera) Bol. Mus. Nac., Zool. No. 86, 1–23, XIV pls.

NOTES ON EUSTERA TROGOPHYLLA (HAMPSON)

The genus *Eustera* consists of a group of small Lepidoptera of the family Saturniidae, that are found only in Africa. One of their main characters is that their tails are exceptionally long, but they should not be confused with other long tailed genera of the same family. Some males of *Eustera* possess posterior wings which reach a length of 135 mm., the tail alone measuring 115 mm., whereas the overall width would only be 55 mm. The average length of the tail of *Eustera* is, in proportion, about twice the one of spectacular species belonging to other genera (for instance *Argema mittrei* ♂) ; and since the width of the tail may sometimes be only 1 mm., one realizes how difficult it is to obtain good specimens of *Eustera,* and how delicate they are to handle.

This study was made by Dr. Claude Lemaire at his breeding station in Janville-sur-Juine par Lardy (Seine & Oise), France, from caterpillars collected in French Equatorial Africa by Mr. Rougeot. When Mr. Rougeot discovered some caterpillars of *Eustera trogophylla* in the Gabon equatorial forest, there were very few specimens known of that species and they were considered as extremely rare. Mr. Rougeot had stayed for over ten years in various parts of the Gabon territory, without ever noticing any insect of this species. And, of course, the life cycle of the insect was completely unknown.

Out of 24 pupae handled in France by Dr. Claude Lemaire in his breeding place, he has succeeded in getting 20 imagoes, four of the total having been the victims of parasites. 19 of the specimens thus obtained are in good state. Of these 13 are male and 7 female. Only one (a male) is not in perfect state, there being a malformation on an anterior wing. Eclosions, which lasted about 22 hours, took place from April to July, with a maximum on June 21st. The temperature was between 22 and 26 degrees centigrade, with considerable moisture prevailing.

The caterpillar of another species, *Eustera argiphontes,* collected by Mr. Rougeot at the same time as the ones of the previously mentioned species, has given a magnificent male; this was achieved by Dr. Claude Lemaire on August 26, 1959. It seems the two species of *Eustera* coexist and feed on the same plants. —LUCIEN L. POHL, CORRESPONDING MEMBER, FRENCH NATIONAL MUSEUM OF NATURAL HISTORY.

AN ANNOTATED LIST OF THE LYCAENIDAE (LEPIDOPTERA, RHOPALOCERA) OF THE WESTERN HEMISPHERE

BY WILLIAM PHILLIPS COMSTOCK AND EDGAR IRVING HUNTINGTON

[Continued from LXVII (3, 4), p. 212]

ecbatana Hewitson, W. C., *Thecla*
Type Locality: Amazon.
Location of Type: British Museum (Natural History).
Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 24 (London).
Additional References: Hewitson, W. C., 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 178, vol. 2, pl. 70, figs. 525, 526 (London). (Hewitson considered this as a variety of *cleon* Fabricius.) Druce, H. H., 1907 (June), Proc. Zool. Soc. London, p. 621 (London). (Places *ecbatana* as a synonym of *cleon* Fabricius.)

echelta Hewitson, W. C., *Thecla*
Type Locality: Amazon (Tápajos).
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 109, vol. 2, pl. 44, figs. 187, 188 ♂ (London).

echinita Schaus, William, *Thecla*
Type Locality: Orizaba, Mexico.
Location of Type: United States National Museum, no. 5946 ♀.
Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 418 (Washington, D. C.).

echiolus Draudt, Max, *Thecla echion* form
Type Locality: Mexico.
Location of Type:
Original Description: 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 786, pl. 156-f (Stuttgart) (underside).

echion Linnaeus, Carolus, *Papilio*
Type Locality: "In America".
Location of Type:
Original Description: 1767, Systema Naturae, vol. 1, pt. 2, 12th edition, p. 788 (Holmiae).
Additional Reference: Hewitson, W. C., 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 155, vol. 2, pl. 61, figs. 410, 411 ♂ (London). (Determines *echion* Linnaeus as a female, as described.)

Synonyms: *crolus* Cramer, *megarus* Godart.
Subspecies: *echiolus* Draudt.

echo Edwards, William H., *Lycaena*
Type Locality: California.
Location of Type:
Original Description: 1864 (March), Proc. Ent. Soc. Phila., vol. 2, p. 506 (Philadelphia, Pa.).
Additional Reference: McDonnough, J. H., 1938, Check list, pt. 1, p. 29, no. 475 (Los Angeles, Calif.). (Places *echo* as a subspecies of *pseudargiolus* Boisduval and LeConte.)
Synonyms: *nunenmacheri* Strand.

editha Mead, Theodore L., *Chrysophanus*
Type Locality: Lake Tahoe, near Carnelian Bay, California, July 26. (Cotype series).
Location of Type: Strecker Collection (1 ♂, 1 ♀).
Original Desciption: 1878 (October), Can. Ent., vol. 10, p. 198 (London, Ontario).
Additional Reference: Strecker, Herman, 1900 (March), Lepidoptera, Rhopaloceres and Heteroceres, Supplement no. 3, p. 21 (Reading, Pa.). (Claims the type.)
Synonyms: *vanduzeei* Gunder.
Subspecies: *montana* Field, *meadi* Field syn.

edwardsii Grote, Augustus R. and Coleman T. Robinson, *Thecla*
Type Locality: London, Ontario.
Location of Type: (Neotype in American Museum of Natural History, Queenstown, Ontario.)
Original Description: 1867 (July), Trans. Amer. Ent. Soc., vol. 1, p. 172 (Philadelphia, Pa.).
Additional References: Saunders, W., 1869 (June), Can. Ent., vol. 1, p. 98 (Toronto). Michener, C. D. and C. F. dos Passos, 1942 (November), Amer. Mus. Novitates, no. 1210, p. 4 (New York, N. Y.).
Synonyms: *fabricii* Kirby.

ela Hewitson, W. C., *Thecla*
Type Locality: Cayenne.
Location of Type: British Museum (Natural History).
Original Description: 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 171, vol. 2, pl 67, figs. 488, 489 ♂ (London).
Note: Hewitson *ibid.*, makes *ela* a synonym of *ergina* Hewitson.

elana Hewitson, W. C., *Thecla*
Type Locality: Espiritu Santo, Brazil.
Location of Type: British Museum (Natural History).
Original Description: 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 170, vol. 2, pl. 67, figs. 482, 483 ♂ (London).

electryon Goodson, F. W., *Thecla*
Type Locality: Equateur, Balzapamba, Prov. de Bolivar, November 1893 to February 1894. Female March–April, 1894, (3 ♂♂, 1 ♀). Huancabamba, Cerra de Pasco, N. E. Peru, (1 ♀). Colombia (1 ♂).
Location of Type: British Museum (Natural History).
Original Description: 1945 (December), Entomologist, vol. 78, p. 184 (London).

elegans Lathy, Percy I., *Thecla*
Type Locality: Paraguay.
Location of Type: Fournier Collection, Paris.
Original Description: 1936, Livre jubilaire de M. Eugene-Louis Bouvier, p. 230, pl. 8, fig. 4 (Paris).

eliatha Hewitson, W. C., *Thecla*
Type Locality: Brazil.
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 112, vol. 2, pl. 41, figs. 141, 142 ♂ (London).

elika Hewitson, W. C., *Thecla*
Type Locality: "Rio Grande".
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 101, vol. 2, pl. 41, figs. 143, 144 ♂ (London).

elimes Dyar, Harrison G., *Thecla*
Type Locality: Trinidad River, Panamá.
Location of Type: United States National Museum, no. 15,756.
Original Description: 1915, Proc. U. S. Natl. Mus., vol. 47, p. 149 (Washington, D. C.).
Additional Reference: Schaus, William, 1920, Ent. News, vol. 31, p. 176 (Philadelphia, Pa.). (Makes *elimes* a synonym of *uterkudante* Druce.)

elis Cramer, Pierre, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1779, Papillons exotiques des trois parties du monde, vol. 3, p. 70, pl. 233, fig. D (Amsterdam).

ella Draudt, Max, *Thecla*
Type Locality: Colombia and Ecuador.
Location of Type:
Original Description: 1919 (November), The Macrolepidoptera of the World, vol. 5, p. 750, pl. 148-b (as *mavors*) (Stuttgart).

ellida Hewitson, W. C., *Thecla*
Type Locality: Venezuela.
Location of Type: British Museum (Natural History).

Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 88, vol. 2, pl. 34, figs. 62, 63 ♂, 64 ♀ (London).

elongata Hewitson, W. C., *Thecla*
Type Locality: Sarayaco, Ecuador.
Location of Type: British Museum (Natural History).
Original Description: 1870 (March), Equatorial Lepidoptera, Buckley, p. 60 (London).
Additional Reference: Hewitson, W. C., 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 173, vol. 2, pl. 68, figs. 495, 496 ♂ (London).

elsa Hewitson, W. C., *Thecla*
Type Locality: Chiriquí, Panamá.
Location of Type: British Museum (Natural History).
Original Description: 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 198, vol. 2, pl. 79, figs. 639, 640 ♀ (London).
Synonyms: *primnoza* Dyar, *primno* Godman and Salvin.

ematheon Cramer, Pierre, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1777, Papillons exotiques des trois parties du monde, vol. 2, p. 104, pl. 163, figs. F, G (Amsterdam).
Additional Reference: Druce, H. H., 1909 (September), Trans. Ent. Soc. London, p. 432, pl. 11, fig. 5 ♂ (London). (Gives locality Perené River, Peru, 2,000 ft.)

embla Kirby, W. F., *Plebeius* (not Edwards) Nomen nudum
Type Locality:
Location of Type:
Original Description: 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 653, no. 326 (London).
Additional Reference: Scudder, Samuel H., 1876 (May), Bull. Buffalo Soc. Nat. Sci. vol. 3, p. 124 (Buffalo, N. Y.). (Says there was no description of *embla* Edwards.)

emendatus Druce, Hamilton H., *Thecla*
Type Locality: Río Juntas, Bolivia, 3,000 ft.
Location of Type: Druce Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 619, pl. 36, fig. 20 ♂ (London).

emessa Hewitson, W. C., *Thecla*
Type Locality: Amazon.
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 111, vol. 2, pl. 42, figs. 160, 161 ♂ (London).
Synonyms: *legytha* Hewitson.

emigdionis Grinnell, Fordyce Jr., *Lycaena*
Type Locality: San Emigdio Canon, Kern County, California, June 3, 4, 1904.

Location of Type: American Museum of Natural History.
Original Description: 1905 (April), Ent. News, vol. 16, p. 115 (Philadelphia, Pa.).
Synonyms: *melimona* Wright.

empetri Freeman, T. N., *Plebeius scudderi* var.
Type Locality: Baddeck, Nova Scotia, July 3, 1936.
Location of Type: Canadian National Collection, no. 4347, Ottawa, Canada.
Original Description: 1938 (March), Can. Ent., vol. 70, no. 3, p. 62, figs. 1, 2, 5 (Orillia, Ontario).

empusa Hewitson, W. C., *Thecla*
Type Locality: Amazon (Pará).
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 106, vol. 2, pl. 42, figs. 158, 159 ♂ (London).
Synonyms: *bethulia* Hewitson, *halciones* Butler and Druce, *tympania* Hewitson.

endela Hewitson, W. C., *Thecla*
Type Locality: Venezuela.
Location of Type: British Museum (Natural History).
Original Description: 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 168, vol. 2, pl. 66, figs. 470, 471 ♂ (London).
Additional Reference: Godman, F. D. and O. Salvin, 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 72, vol. 3, pl. 56, figs. 30, 31 ♀ (London).

endera Hewitson, W. C., *Thecla*
Type Locality: Amazon (Ega).
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 111, vol. 2, pl. 42, figs. 156, 157 ♂ (London).
Synonyms: *thestia* Hewitson.

endymion Fabricius, Johann Christian, *Papilio*
Type Locality: Brazil.
Location of Type: Originally in Banksian Collection.
Original Description: 1775, Systema Entomologia, p. 519 (Flensburgi).
Synonyms: *xenophon* Donovan, *hugon* Godart, *hugo* Doubleday.

endymion Fabricius, Johann Christian, *Papilio*
Type Locality:
Location of Type:
Original Description: 1781, Species Ins., vol. 2, p. 115 (Hamburgi).
Note: Synonym of *regalis* Cramer by Fabrician reference.

endymion Blanchard, E., *Lycaena*
Type Locality: Coquimbo, Chile.

Location of Type:

Original Description: 1852, Historia Física y Política de Chile, Zoologica, vol. 7, p. 37 (Paris); 1854, Atlas, vol. 2, Zoologica, Lepidoptera, pl. 2 (3), figs. 3-a, 3-b, (Paris) (Gay's Fauna of Chile).

Additional Reference: Ureta R., Emilio, 1949, Boletín del Museo Nacional de Historia Natural, vol. 24, p. 113 (Santiago, Chile). (Places *endymion* in *Itylos.*)

Synonyms: *sibylla* Kirby.

endymion Holland, W. J., *Thecla* (not Fabricius)

Type Locality: Haiti.

Location of Type: Carnegie Museum, Pittsburgh, Pennsylvania.

Original Description: 1931, Butterfly Book, p. 242, pl. 64, fig. 32 ♂ (New York, N. Y.). Revised edition.

Additional Reference: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 70 (New York, N. Y.). See also remarks p. 54.

enenia Hewitson, W. C., *Thecla*

Type Locality:

Location of Type: British Museum (Natural History).

Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 108, vol. 2, pl. 41, figs. 146, 147 ♂ (London)

enoptes Boisduval, Jean A., Lycaena

Type Locality: California. May, in dry sections.

Location of Type: United States National Museum?

Original Description: 1852, Ann. Soc. Ent. France, Series 2, vol. 10, p. 298 (Paris).

Additional Reference: Oberthür, Charles, 1913 (October), Etudes de Lepidopterologie Comparee, fasc. 9, pt. 1, p. 41, pl. 237, fig. 1948 ♂, 1949 ♀ (Rennes).

Subspecies: *ancilla* Barnes and McDonnough, *dammersi* Comstock and Henne, *columbiae* Mattoni, *smithi* Mattoni.

epidius Godman, F. D. and O. Salvin, *Thecla*

Type Locality: Chiriquí, Panamá, and San Juan River, Western Colombia.

Location of Type: British Museum (Natural History).

Original Description: 1887 (August), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 54, vol. 3, pl. 54, figs. 21, 22 ♂ (San Juan River) (London).

Additional Reference: Draudt, Max, 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 778, pl. 155-f (Stuttgart). (Places *epidius* as a subspecies of *doryasa* Hewitson.)

episcopalis Fassl, A. H., *Thecla*

Type Locality: Río Aguaca Valley, Colombia, 2,000 meters.

Location of Type: Fassl Collection. (Now in Naturhistoriches Museum, Basle.)

Original Description: 1912, Rev. Mens. Soc. Ent. Namur, N. 4 (Namur).

Note: Data from M. Draudt, 1919, The Macrolepidoptera of the World, vol. 5, pp. 747, 827, pl. 153-a (Stuttgart).

epixanthe Boisduval, Jean A. and John LeConte, *Polyommatus*
Type Locality: New Harmony, Indiana.
Location of Type:
Original Description: 1833, Histoire Générale et iconographie des Lépidoptères et des chenilles de l'Amérique Septentrionale, p. 127, pl. 38, figs. 4, 5 (Paris).
Synonyms: *hypoxanthe* Kirby.
Subspecies: *phaedrus* Hall, *amicetus* Doubleday syn.

epopea Hewitson, W. C., *Thecla*
Type Locality: Curaray, Ecuador.
Location of Type: British Museum (Natural History).
Original Description: 1870 (March), Equatorial Lepidoptera, Buckley, p. 61 (London).
Additional Reference: Hewitson, W. C., 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 168, vol. 2, pl. 66, figs. 473, 474 ♂, 472 ♀ (London).

epopeoides Schaus, William, *Thecla*
Type Locality: Coatepec, Mexico.
Location of Type: United States National Museum, no. 5933 ♀.
Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 412 (Washington, D. C.).

epytus Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Bugaba, Panamá.
Location of Type: British Museum (Natural History).
Original Description: 1887 (May), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 40, vol. 3, pl. 52, figs. 27, 28 ♂, fig. 29 ♀ (London).

erema Hewitson, W. C., *Thecla*
Type Locality: Guatemala (Vera Paz).
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 104, vol. 2, pl. 44, figs. 179, 180 ♂ (London).
Additional References: Hewitson, W. C., 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 182, vol. 2, pl. 72, figs. 550, 551 ♂ (London). Godman, F. D. and O. Salvin, 1887 (June), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 46, vol. 3, pl. 53, figs. 23, 24 ♂ (type) (London). (They say: "The type described by Hewitson was taken by us during an expedition to the forest region of Vera Paz, north of Coban, at an elemation of about 1500 feet above the sea.")

eremica Hayward, Kenneth J., *Thecla*
Type Locality: Catamarca, Argentina.
Location of Type: Fundación Miguel Lillo, Tucumán.

Original Description: 1949, Acta Zool. Lilloana, vol. 8, p. 574, pl., fig. 1 (Tucumán).
Note: Hayward states this species resembles *valentina* Berg.

erenea Hewitson, W. C., *Thecla stagira* var.
Type Locality: Amazon (Santarem).
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 113, vol. 2, pl. 42, figs. 163, 164 ♂ (London).
Additional Reference: Draudt, Max, 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 777 (Stuttgart). (Places *erenea* as a form of *spurina* Hewitson.)

ergeus Godart, Jean B., *Polyommatus*
Type Locality: Antilles.
Location of Type:
Original Description: 1822, Encyclopédie Méthodique, vol. 9, p. 635 (Paris).
Additional Reference: Druce, H. H., 1907, Proc. Zool. Soc. London, p. 568 (London). (Did not recognize the species.)

ergina Hewitson, W. C., *Thecla*
Type Locality: Jamaica?
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 105, vol. 2, pl. 43, figs. 170, 171 ♂ (London).
Additional Reference: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 56 (New York, N. Y.). (Recognize it from Trinidad, Venezuela and Brazil.)
Synonyms: *ela* Hewitson.

eribaea Hewitson, W. C., *Thecla*
Type Locality: Amazon (Pará).
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 108, vol. 2, pl. 42, figs. 154, 155 ♂ (London).

ericeta Hewitson, W. C., *Thecla*
Type Locality: Guatemala (Vera Paz).
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 104, vol. 2, pl. 44, figs. 177, 178 ♂ (London).
Additional Reference: Godman, F. D. and O. Salvin, 1887 (August), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 58, vol. 3, pl. 55, figs. 3, 4 ♂ (London). (Say Hewitson's figures inadequately represent this species.)
Synonyms: *munatia* Hewitson.

ericusa Hewitson, W. C., *Thecla*
Type Locality: Brazil.

Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 113, vol. 2, pl. 42, fig. 162 ♀ (London).
Synonyms: *voconia* Hewitson.

eriphon Morris, John G., *Thecla* (not Boisduval). See *eryphon* Boisduval
Type Locality: California.
Location of Type:
Original Description: 1862 (February), Catalogue of the Described Lepidoptera of North America, p. 100 (Washington, D. C.). (Smithsonian Misc. Collections.)

erissus Draudt, Max, *Thecla* (not Herbst). See *eryssus Herbst*
Type Locality:
Location of Type:
Original Description: 1920 (January), The Macrolepidoptera of the World, vol. 5, p. 776 (Stuttgart).

erix Cramer, Pierre, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1775, Papillons exotiques des trois parties du monde, vol. 1, p. 129, pl. 82, fig B (Amsterdam).
Additional Reference: Hewitson, W. C., 1869 (April), Illus. of Diurnal Lepidoptera, vol. 1, p. 102, vol. 2, pl. 46, figs. 203, 204 ♂ (London).
Note: *Papilio erix* is a homonym of *Papilio eryx* Linnaeus (1771). It is a synonym of *Papilio eryssus* Herbst.)

eronos Druce, Hamilton H., *Thecla*
Type Locality: Interior of Colombia.
Location of Type: Druce Collection.
Original Description: 1890, Ent. Mo. Mag., Series 2, vol. 1, p. 151 (London).
Additional Reference: Druce, H. H., 1907 (June), Proc. Zool. Soc. London, p. 573, pl. 31, fig. 9 ♂ type (London).

erybathis Hewitson, W. C., *Thecla*
Type Locality: Mexico.
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 84, vol. 2, pl. 34, figs. 58, 59 ♂ (London).
Additional Reference: Godman, F. D. and O. Salvin, 1901 (October), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 715, vol. 3, pl. 111, figs. 3, 4 ♀ (London).

erymus Boisduval, Jean A., *Lycaena*
Type Locality: Oregon.
Location of Type: United States National Museum.
Original Description: 1869, Ann. Soc. Ent. Belgique, vol. 12, p. 48 (Bruxelles).

Additional References: Oberthür, Charles, 1913 (October), Etudes de Lepidopterologie Comparee, fasc. 9, pt. 1, p. 42, pl. 239, figs. 2069 ♂, 2070 ♀ (Rennes). McDunnough, J. H., 1938, Check List, pt. 1, p. 27, no. 456 (Los Angeles, Calif.). (Places *erymus* as a synonym of *pardalis* Behr.)

eryphon Boisduval, Jean A., *Thecla*
Type Locality: California.
Location of Type: United States National Museum?
Original Description: 1852, Ann. Soc. Ent. France, Series 2, vol. 10, p. 290 (Paris).
Additional Reference: Oberthür, Charles, 1913 (October), Etudes de Lepidopterologie Comparee, fasc. 9, pt. 1, p. 40, pl. 236, fig. 1925 (Rennes).
Subspecies: *sheltonensis* Chermock and Frechin.

eryssus Herbst, Johann Friedrich Wilhelm, *Papilio*
Type Locality:
Location of Type:
Original Description: 1800, Natursystem aller bekannten in und ausländischen Insekten, vol. 10 p. 316, pl. 294, fig. 3 (Berlin). Made a new name for *erix* Cramer.
Additional References: Kirby, W. F., 1877, A Synonymic Catalogue of Diurnal Lepidoptera, Supplement, p. 774, no. 166 (London). (Places *eryssus* in the synonymy of *erix* Cramer, which is a homonym.) Draudt, Max, 1920 (January), The Macrolepidoptera of the World, vol. 5, p. 776 (Stuttgart). (Places *erissus* in the synonymy of *erix* Cramer.)
Synonyms: *erix* Cramer, *tyrrhenus* Hubner.

erytalus Butler, A. G., *Tmolus*
Type Locality:
Location of Type:
Original Description: (1869) 1870, Catalogue of Diurnal Lepidoptera Described by Fabricius in the Collection of the British Museum, p. 189 (London).
Additional Reference: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 80 (New York, N. Y.). (Make *erytalus* a synonym of *columella* Fabricius.)

eryx Cramer, Pierre, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1777, Papillons exotiques des trois parties du monde, vol. 2, p. 75, pl. 143, fig. D (Amsterdam).
Note: *Papilio eryx* Cramer is a homonym of *Papilio eryx* Linnaeus (1771). It is a synonym of *Bithys lydus* Hübner.
Synonyms: *ingae* Sepp, *lebena* Hewitson.
Subspecies: *occidentalis* Lathy.

esmeralda Jones, E. Dukinfield, *Thecla*
Type Locality: Castro, Paraná, Brazil.

Location of Type: Jones Collection.
Original Description: 1912, Proc. Zool. Soc. London, p. 900, pl. 97, figs. 10, 11 (London).

essus Herrich-Schäffer, G. A. W., *Thecla*
Type Locality: Surinam.
Location of Type:
Original Description: 1853, Sammlung aussereuropäisher Schmetterlinge, p. 55, pl. 14, figs. 59, 60 (Regensburg).

estesi Clench, Harry K., *Atlides halesus corcorani,* normal form
Type Locality: Riverside, California, October 6, 1940.
Location of Type: Museum of Comparative Zoology, no. 25,703. (Paratype in American Museum of Natural History.)
Original Description: 1942 (October), Ent. News, vol. 53, no. 8, p. 219 (Philadelphia, Pa.).

ethemon Cramer, Pierre, *Papilio*
Type Locality: "Indes Occidentales."
Location of Type:
Original Description: 1775, Papillons exotiques des trois parties du monde, vol. 1, p. 75, pl. 48, fig D (Amsterdam).
Additional Reference: Druce, H. H., 1907, Proc. Zool. Soc. London, p. 568 (London). (Did not recognize the species.)

eumenia Hewitson, W. C., *Theorema*
Type Locality: New Granada.
Location of Type: British Museum (Natural History).
Original Description: 1865, Illus. of Diurnal Lepidoptera, vol. 1, p. 69, vol. 2, pl. 27, figs 1, 2 ♂ (London).
Synonyms: *eunomia* Strecker, *titania* Strecker.

eumorpha Hayward, Kenneth J., *Thecla*
Type Locality: Puerto Bemberg, Misiones, Argentina.
Location of Type: Museo Argentino de Ciencias Naturales, Buenos Aires. (Series in British Museum (Natural History) from Brazil.)
Original Description: 1949, Acta Zool. Lilloana, vol. 8, p. 572, pl., fig. 6 (Tucumán, Argentina).
Note: Hayward says this species is in the *celmus* group and that it is very similar to *lucagus* Godman and Salvin.)

eunomia Kirby, W. F., *Plebeius* (not Edwards) Nomen nudum
Type Locality:
Location of Type:
Original Description: 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 653, no. 328 (London).
Additional Reference: Scudder, Samuel H., 1876 (May), Bull. Buffalo Soc. Nat. Sci., vol. 3, p. 124 (Buffalo, N. Y.). (Says there was no description of *eunomia* Edwards.)

eunomia Strecker, Herman, *Theorema* (not Hewitson), Misspelling of *eumenia* Hewitson
Type Locality:
Location of Type:
Original Description: 1900 (March), Lepidoptera, Rhopaloceres and Heteroceres, Supplement no. 3, p. 20 (Reading, Pa.).

eunus Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Polochic Valley, Guatemala.
Location of Type: British Museum (Natural History).
Original Description: 1887 (May), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 30, vol. 3, pl. 51, figs. 25, 26 ♂ (London).

eurepes Hayward, Kenneth J., *Ipidecla*
Type Locality: Santa María, Misiones, Argentina.
Location of Type: Breyer Collection, Oruro, Bolivia.
Original Description: 1949, Acta Zool. Lilloana, vol. 8, p. 579, pl., fig. 5 (Tucumán, Argentina).

euptychia Draudt, Max, *Thecla*
Type Locality: South Brazil.
Location of Type: Museu Paulista (♂).
Original Description: 1920 (December), The Macrolepidoptera of the World, vol. 5, p. 811, pl. 145–1 (underside) (Stuttgart).

euripedes Kirby, W. F., *Thecla* (not Fabricius) Misspelling of *euripides* Fabricius
Type Locality:
Location of Type:
Original Description: 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 398 (London).

euripides Fabricius, Johann Christian, *Hesperia*
Type Locality: "In Indiis."
Location of Type:
Original Description: 1793, Entomologica Systematica, vol. 3, p. 267 (Hafniae).
Additional Reference: Butler, A. G., 1870, Catalogue of Diurnal Lepidoptera Described by Fabricius in the Collection of the British Museum, p. 190 (London). (Places *euripides* as the female of *ixion* Fabricius.)
Synonyms: *euripedes* Kirby.

eurisides Hübner, Jacob, *Jölaus*
Type Locality: Brazil.
Location of Type:
Original Description: 1823, Zuträge zur Sammlung exotischer Schmettlinge, vol. 2, p. 20, pl. (52), figs. 297, 298 (Augsburg).
Additional Reference: Kirby, W. F., 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 384 (London). (Gives the misspelling of *eurysides*, and makes it a synonym of *melibaeus* (= *meliboeus* Fabricius.)

eurysides Kirby, W. F., *Iolaus* (not Hübner) See *eurisides*
Type Locality:
Location of Type:
Original Description: 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 384 (London).

eurytulus Hübner, Jacob, *Tmolus*
Type Locality:
Location of Type:
Original Description: 1819, Sammlung exotischer Schmetterlinge, vol. 2, pl. (90) (Augsburg), (Hemming).
Additional Reference: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 87 New York, N. Y.). (Recognize *eurytulus* as occurring at Santa Catharina, Brazil.)
Synonyms: *argona* Hewitson, *rana* Schaus.
Subspecies: *nigra* Lathy.

evius Boisduval, Jean A., *Lycaena*
Type Locality: Southern California.
Location of Type: United States National Museum?
Original Description: 1869, Ann. Soc. Ent. Belgique, vol. 12, p. 49 (Bruxelles).
Additional References: Oberthür, Charles, 1913 (October), Etudes de Lepidopterologie Comparee, fasc. 9, pt. 1, p. 42, pl. 239, fig. 2072 ♂, 2073 ♀ (Rennes). McDunnough, J. H., 1938, Check list, pt. 1, p. 27, no. 455 (Los Angeles, Calif.). (Places *evius* as a subspecies of *icarioides* Boisduval.)

excisicosta Dyar, Harrison G., *Thecla*
Type Locality: Cotahuasi, 9,000 ft., October, 1911; Chuquibamba, 10,000 ft., October, 1911, Peru.
Location of Type: United States National Museum, no. 15,625 (6 cotypes).
Original Description: 1913, Proc. U. S. Natl. Mus., vol. 45, p. 637 (Washington D. C.).

exiguus Druce, Hamilton H., *Thecla*
Type Locality: Surinam.
Location of Type: Druce Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 580, pl. 33, fig. 5 ♂ (London).

exile Scudder, Samuel H., *Brephidium* (not Boisduval) See *exilis* Boisduval
Type Locality:
Location of Type:
Original Description: 1876 (May), Bull. Buffalo Soc. Nat. Sci., vol 3, p. 124 (Buffalo, N. Y.). (Scudder changed the gender to neuter to agree with his genus.)

exilis Boisduval, Jean A., *Lycaena*

Type Locality: California.

Location of Type: United States National Museum.

Original Description: 1852, Ann. Soc. Ent France., Series 2, vol. 10, p. 294 (Paris).

Additional References: Godman, F. D. and O. Salvin, 1887 (December), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 109, vol. 3, pl. 58, figs. 30, 31 ♂, 32 ♀ (London). Oberthür, Charles, 1913 (October), Etudes de Lepidopterologie Comparete, fasc. 9, pt. 1, p. 41, pl. 236, fig. 1935 ♀ Rennes). Type figure. Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 110 (New York, N. Y.).

Synonyms: *coolidgei* Gunder, *fea* Edwards.

Subspecies: *isophthalma* Herrich-Schaffer, *thompsoni* Carpenter and Lewis.

exoleta Edwards, Henry, *Thecla nelsoni* var.

Type Locality: Big Trees, Calaveras County, California.

Location of Type: American Museum of Natural History (2 ♀♀).

Original Description: 1881 (April), Papilio, vol. 1, p. 53 (New York, N. Y.).

extrema Draudt, Max, *Thecla ion* form

Type Locality: Medina, East Colombia.

Location of Type: Fassl Collection. (Now in Naturhistorisches Museum, Basle.)

Original Description: 1919 (December), The Macrolepidoptera of the World, vol. 5, p. 754, pl. 153-d (Stuttgart).

[To be continued]

The

New York Entomological Society

Organized June 29, 1892—Incorporated February 25, 1893
Reincorporated February 17, 1943

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 79th St., & Central Park W., New York 24, N. Y.

Annual dues for Active Members, $4.00; including subscription to the Journal, $9.00.

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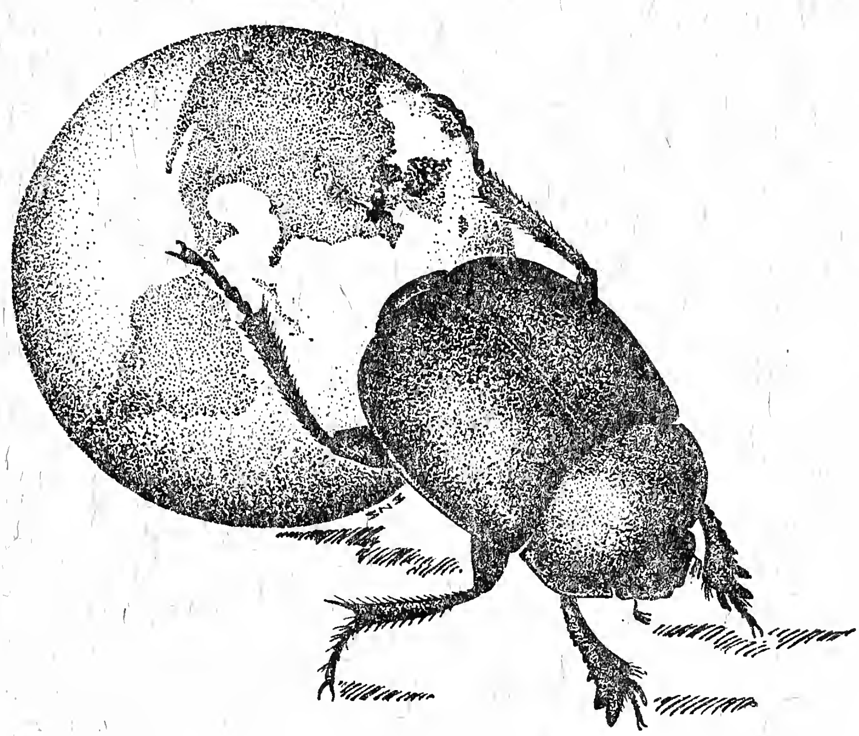

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# Journal of the New York Entomological Society

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HAROLD R. HAGAN, 1886–1960

The New York Entomological Society learns with regret of the death of its former President, Harold R. Hagan. Although Dr. Hagan was a member of the Society for many years, his active participation in its affairs began when he assumed the presidency in 1947. During his two years of office he was instrumental in putting the financial affairs of the Society on a sound basis. In subsequent years he became concerned over the rising costs in the publication of the Journal. He was chairman of the Printing Committee, which was instructed to study the problem and to make recommendations for its solution to the Trustees. On the advice of the Printing Committee a decision was made, in 1953, to change printers. It is impossible to say what effect this change might have had if Dr. Hagan had been able to continue his policies. Ill health forced his retirement from City College in the fall of 1953. After retirement he often corresponded with Frank Soraci from his home in Alma, Nebraska. His letters clearly show that Dr. Hagan was deeply interested in the welfare of the Society. His death deprives the Society of one of its staunchest supporters.

It will be difficult for many of the present generation to appreciate Dr. Hagan's scholastic achievements, for his youth was spent in an era when higher education was neither free nor subsidized. In order to secure funds for a college education Hagan worked for eight years, first with Wells-Fargo and later with the Pacific Express Company. It is significant that he headed several departments in the latter company before he left it in 1911 to attend Utah Agricultural College. At this time he was twenty-five years old.

After acquiring his bachelor's degree from Utah Agricultural College in 1914, Hagan taught there for three years. A large part of his duties at this time consisted of work in the Agricultural Experiment Station. This work necessitated trips to outlying ranches and farms. Hagan usually made these trips by motorcycle. Anyone familiar with the secondary roads in the vicinity of Logan at that period will appreciate that this was no mean accomplishment in itself. In 1917 Hagan went to Harvard for graduate work at the Bussey Institution. It is not surprising that W. M. Wheeler, under whom he studied, roused his interest in insect embryology, for Wheeler's original interest had been in this field. After receiving his M.S. from Harvard, Hagan returned to Utah Agricultural College where he became Assistant Professor in the Department of Zoölogy and Entomology. In 1919 he was given leave from the College to enable him to serve as the head of the Utah State Crops and Pests Commission. After two years service as Commissioner, Hagan became Associate Professor in the Department of Zoölogy and Botany of the University of Utah, where he spent the next seven years.

In 1928 the National Biscuit Company secured Hagan's services as consultant in a problem that had arisen from the shipping methods used by the suppliers of Turkish figs. The shipments were so highly contaminated with dead insects that many of them had to be discarded. Hagan was sent to Turkey with instructions to take whatever steps were necessary to improve the shipments. His sojourn in Turkey was spent in a rather primitive area and he had many amusing stories to tell of the difficulties that were encountered. Since the sanitary conditions were none too good, Hagan relied largely on eggs as a safe source of food. But the climate was so hot that when fertilized eggs were taken from under a hen they would continue to develop. A fresh egg was, therefore, one in which the embryo was not more than forty-eight hours old. In time, according to Hagan, he learned to relish eggs whose embryos were considerably more advanced. Despite the primitive conditions under which he had to work, Hagan was highly successful in disposing of the problem of insect contamination. He ultimately superintended the construction of a cleaning and sorting plant which was built on the basis of his recommendations.

After completing his assignment in Turkey, Hagan did gradu-

ate work at Leland Stanford University which earned him a doctorate in 1929. Thereafter he went to Hawaii, where he became Associate Nematologist at the Pineapple Research Station of the University of Hawaii. He returned to the United States in 1932 and a year later began teaching in the Biology Department at City College. Dr. Hagan's wide experience made him a versatile teacher. At various times he taught General Biology, Histology and Embryology. In the preparation of course material Hagan was methodical and thorough to a fault.

Dr. Hagan published more than forty papers most of which deal with entomology. His primary interest lay in the study of insect embryology. He was particularly attracted by the embryology of insects which bear living young, and became an authority in this field. His book, *Embryology of the Viviparous Insects,* brought him the Cressy Morrison Prize from the New York Academy of Sciences in 1949 and is generally regarded as a classic presentation of this subject.

Toward the end of his life Dr. Hagan's health was further complicated by a malignant abdominal condition which necessitated repeated operations. The last of these occurred late in 1959. He died at his home in Alma, Nebraska on January 18, 1960.—WM. S. CREIGHTON, *Department of Biology, City College.*

NOTE ON THE NATURAL LONGEVITY OF FERTILE FEMALES OF APHAENOGASTER PICEA

In the course of an experimental program dealing with the production of impaternate females in the Myrmicine ants *Aphaenogaster picea* and *A. lamellidens* (Haskins and Enzmann, 1945) a number of mature fertile females of *A. picea* with normal colonies were kept under observation in modified Lubbock nests for fairly prolonged periods, ranging up to thirteen years. In the course of this work it was possible to observe a total of eleven such females throughout most of their normal life spans, and to record the extent of the spans when terminated apparently normally. Since similar spans have not, to my knowledge, been recorded for the genus *Aphaenogaster* it seems worth while to report them. They are shown in Table 1.

TABLE 1

Number of Female	Age at Death: Years	Age at Death: Months
1	4	7
2	7	4
3	7	7
4	8	0
5	8	1
6	8	1
7	9	1
8	9	7
9	9	11*
10	10	7
11	13	1

* Accidentally killed

The conditions under which these females were maintained corresponded fairly closely to the natural ones except in one respect—the fact that during the winter they were maintained at ordinary room temperatures and did not, therefore, become dormant. In all but one case death occurred apparently normally and the female (the only one in the colony in each instance) was survived for a considerable time by the younger workers. Reproduction continued almost until death, though the percentage of males produced rose. It was not possible to ascertain the parentage of

these males, but it is clear either that the proportionate number of surviving progeny of the female fell in the last year of life or that the percentage of males in the female progeny rose. In the case of number 11 all production of young workers ceased about a year before the death of the queen, suggesting exhaustion of the contents of the spermatheca, as has been recorded for the aged fertile females of other ants.—CARYL P. HASKINS, *Carnegie Institution of Washington.*

HASKINS, C. P. and E. V. ENZMANN. 1945. On the occurrence of impaternate females in the Formicidae. Jour. N. Y. Ent. Soc. **53**, 263–277.

PAUL EHRLICH COLLECTION

It is with great pleasure that the Department of Insects and Spiders of the American Museum of Natural History announces the gift of the *Erebia* (Lepidoptera, Satyridae) collection of Dr. Paul R. Ehrlich. This collection contains series of all the named North American species and subspecies in this genus, and numbers 2193 specimens, including 122 paratypes and 132 genitalic preparations. This collection is probably the finest one of this genus from North America ever built up by a private collector. In fact, a number of the populations included in it are not even represented in most museum collections.

Dr. Ehrlich, now of the Department of Biological Sciences at Stanford University, has collected the group extensively in the arctic and subarctic regions of Canada and Alaska. In this way he has been able to obtain many specimens, as well as much valuable information on their ecology, occurrence, and flight habits. Additional series of specimens have been obtained from other collectors in areas where the genus is represented.

Dr. Ehrlich is continuing his building up of the collection, as well as his revisionary work in this genus.—FREDERICK H. RINDGE, *The American Museum of Natural History.*

THE TROGLOBITIC MILLIPED GENUS ZYGONOPUS (CHORDEUMIDA, CONOTYLIDAE, TRICHOPETALINAE)

BY NELL B. CAUSEY
FAYETTEVILLE, ARKANSAS

In many of the caves from Virginia south to Alabama and Georgia and west to Missouri, there are small, depigmented, eyeless millipeds of two genera of the family Conotylidae. *Scoterpes,* the larger and more complex of these genera, occurs in the southern part of the area and *Zygonopus* in the northern part. Their ranges are not known to overlap. Specimens occur in remote regions of caves, where they are found crawling on damp floors, walls, or pieces of organic matter such as wood, paper, or the excrement of other cave animals. Neither genus is known to have epigean forms.

ACKNOWLEDGMENTS

I am indebted to the following for their generous cooperation: Dr. Carl H. Krekeler, whose collection furnished material for my introductory work on the genus; Mr. H. F. Loomis, who contributed a topotype of *Zygonopus whitei;* Mr. Oscar P. Estes, who made a trip to Grand Caverns especially to collect specimens of the species described here as *Z. weyeriensis;* and to Dr. Thomas C. Barr, Jr., who contributed more than 200 specimens.

DEPOSITION OF SPECIMENS

The male holotypes and female paratypes of *Z. krekeleri, Z. packardi,* and *Z. weyeriensis* will be deposited in the American Museum of Natural History. Topotypes or paratypes of all species will be deposited in the United States National Museum. The remaining specimens will be retained in the author's private collection. The location of the type specimens of *Z. whitei* is unknown.

KEY TO THE TROGLOBITIC GENERA OF THE TRICHOPETALINAE

1. Segmental setae of most body segments arranged in a forwardly curved row on each side of the dorsum. Fourth segment of the sixth legpair

of the male bowed and the entire leg conspicuously thicker and longer than any others .... *Zygonopus* Ryder

2. Segmental setae of most body segments arranged in an oblique row on each side of the dorsum. Fourth segment of the sixth legpair of the male never bowed and the entire leg never longer than any other .... *Scoterpes* Cope

The epigean genus *Trichopetalum,* which is represented by species from Newfoundland to Colorado, appears to be the genus most closely related to *Zygonopus.* Epigean species of the Trichopetalinae tend to be more conservative than the troglodytic species, specimens of some species having been collected from sites more than 800 miles apart.

HISTORY

Because of their similarities in habitat and morphology, the histories of the genera *Zygonopus* and *Scoterpes* are interwoven. *Scoterpes* was proposed by E. D. Cope (1872) for *Spirostrephon copei* Packard 1871. *Zygonopus* was proposed by J. A. Ryder (1881) for a new species, *whitei,* described from specimens from Luray Cave that had previously been identified as *Spirostrephon copei.* Ryder recognized the importance of the enlarged sixth legs of the male as a generic character and published a poor figure of them; he did not describe the gonopods. A. S. Packard put *Scoterpes* and *Zygonopus* into the genus *Spirostrephon* in 1881, but later he recognized them both (1883), as did Jerome McNeill (1888). Packard (1883), like Ryder, miscounted the number of body segments, but he wrote a fairly good description of *Zygonopus;* he noted that the segmental setae are not as coarse or as long as they are in *Scoterpes,* described the gonopods, and later (1886) published figures of them. The form that he described is published here as a new species, *Zygonopus weyeriensis.* In Charles H. Bollman's posthumously published work (1893), *Scoterpes* and *Zygonopus* were combined in one paper and listed as separate genera in another. Cook and Collins (1895) recognized both genera and gave detailed descriptions and figures of *Z. whitei.* H. F. Loomis (1939) called attention to the difference in the arrangement of the segmental setae in the two genera.

Genus *Zygonopus* Ryder

Zygonopus Ryder, 1881, Proc. U. S. Natl. Mus., vol. 3, no.

181, p. 527. Packard, 1883, Proc. Amer. Phil. Soc., vol. 21, pp. 194–195; 1886, Natl. Acad. Sci., vol. 4, p. 63. McNeill, 1888, Bull. Brookville Soc. Nat. Hist., no. 3, p. 9. Bollman, 1893, U. S. Natl. Mus., bull. 46, p. 158. Cook and Collins, 1895, Ann. N. Y. Acad. Sci., vol. 9, pp. 59–60. Loomis, 1939, Bull. Mus. Comp. Zool., vol. 86, no. 4, p. 182. Chamberlin and Hoffman, 1958, U. S. Natl. Mus., bull. 212, p. 103.

Scoterpes, Bollman, 1893, U. S. Natl. Mus., bull. 46, p. 121.

TYPE SPECIES: *Zygonopus whitei* Ryder, by monotypy.

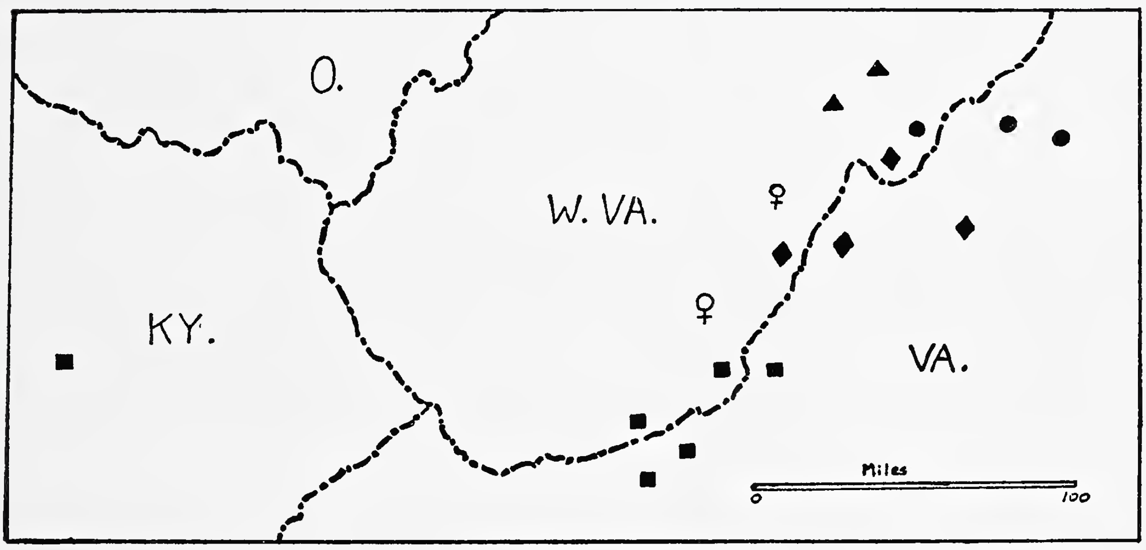


FIG. 1. Distribution of the known species of *Zygonopus*. The approximate location of collection sites of *Z. krekleri* is indicated by triangles, *Z. packardi* by squares, *Z. weyeriensis* by diamonds, and *Z. whitei* by filled circles. Records of specimens of undetermined species are indicated by the female symbol.

RANGE: Seventeen counties along the Virginia-West Virginia boundary and one county in east central Kentucky (fig. 1); the Kentucky record should be reexamined.

SPECIES: Four.

DIAGNOSIS: Trichopetalids of 30 body segments, of moderate length, depigmented, and similar to *Scoterpes* in the absence of ocelli and in the cave habitat, but nearer *Trichopetalum* in the structure of the gonopods, the length and arrangement of the segmental setae, and the shape of the paranota; distinguished especially by the enlarged and bowed sixth legs of the male.

Mentum undivided, the anterior margin straight, and the space between it and the lingual lamellae filled by a triangular membrane. Antennae slender. Exoskeleton thin. Dorsum smooth. Typical paranota with the an-

terio-lateral margin broadly rounded, the width about two-thirds the length. Segmental setae on most segments set in a curved row on each side of the dorsum, with the lateral seta on the caudal angle of the paranotum, the medial seta on the anterior margin of the paranotum, and the internal seta at the same level as the medial seta, but slightly farther from it than the lateral seta is; setae on the posterior segments arranged in a transverse row. Segmental setae acute, the length more than one-half the body width; setae shorter and finer than in *Scoterpes.* Posterior margin of metatergites very finely serrulated; lateral and ventral margins of segments more distinctly serrulated.

Sixth legpair of male longer and thicker than any others and with the fourth segment markedly bowed. No other legs anterior to the gonopods are greatly modified; the first and second are slightly reduced and the third through the fifth may be slightly swollen. Coxae of legpairs 10 and 11 with the usual glands.

Gonopods much as in *Trichopetalum.* Anterior gonopod with two coxites, which are either slender and spinous or broad and membranous. Anterior surface of coxa with a band or a large patch of closely placed, very small, scale-like setae and two groups of longer setae, one group of three setae along the median margin and the other group of several setae on the disto-lateral margin. Telopodite of anterior gonopod[1] thick, usually rectangular, shorter and narrower than the coxa, not visible from a ventral view *in situ,* and with no processes other than the one large and one or two smaller plumose branches that project ventrad between the telopodite and the coxa.

Posterior gonopod composed of two thickened, elongated segments, of which the second one is about one-third longer than the first, has no rudimentary segments at the apex, and usually has no terminal spine. Median surface of first segment with a rounded lobe, which has the opening of the coxal gland in it; base of first segment does not reach to the midline of the sternum. Sternum weak and without ventral lobes.

KEY TO THE SPECIES OF *Zygonopus* BASED ON THE MALE GONOPODS

1. Each anterior gonopod with a broad, membranous, median coxite and a longer, spinous, lateral coxite .... **Z. krekeleri,** new species
   Each anterior gonopod with two spinous coxites, but no membranous coxite 2
2. The two coxites contiguous at the base; the median one long and distinctly curved and the lateral one about as long and slightly curved .... **Z. packardi,** new species
   The two coxites not continguous at the base; almost equal in length and in curvature 3

[1] Palmen (1953, p. 10) referred to the telopodite of the anterior gonopod of *Trichopetalum lunatum* as the "denticulate lamella" and found its connection with the gonopod obscure. In species of *Scoterpes,* in which the anterior gonopod has retained a more primitive condition than in some other genera, it is possible to see the attachment of the plumose branch to the telopodite.

3. Median margin of anterior gonopod almost vertical; median and disto-lateral coxal setae slightly sinuous .... **Z. whitei** Ryder
Median margin of anterior gonopod either broadly rounded or forming a right angle; the median and disto-lateral coxal setae straight .... **Z. weyeriensis,** new species

Zygonopus krekeleri stands distinctly apart from the other known species of the genus. The differences between *Z. packardi, Z. weyeriensis,* and *Z. whitei* are mainly quantitative. When these three species were first studied, it appeared that subsequent collections might yield forms that would connect them. Then Dr. Barr's large collection with male specimens of three species from 12 additional caves was received. Some variations were found, but they are slight, and in no case can they be regarded as integrades between the species. The genus differs markedly from the related genus *Scoterpes,* in which the population of almost every cave is taxonomically distinct from that of any other cave.

Zygonopus whitei Ryder
Figures 2, 3.

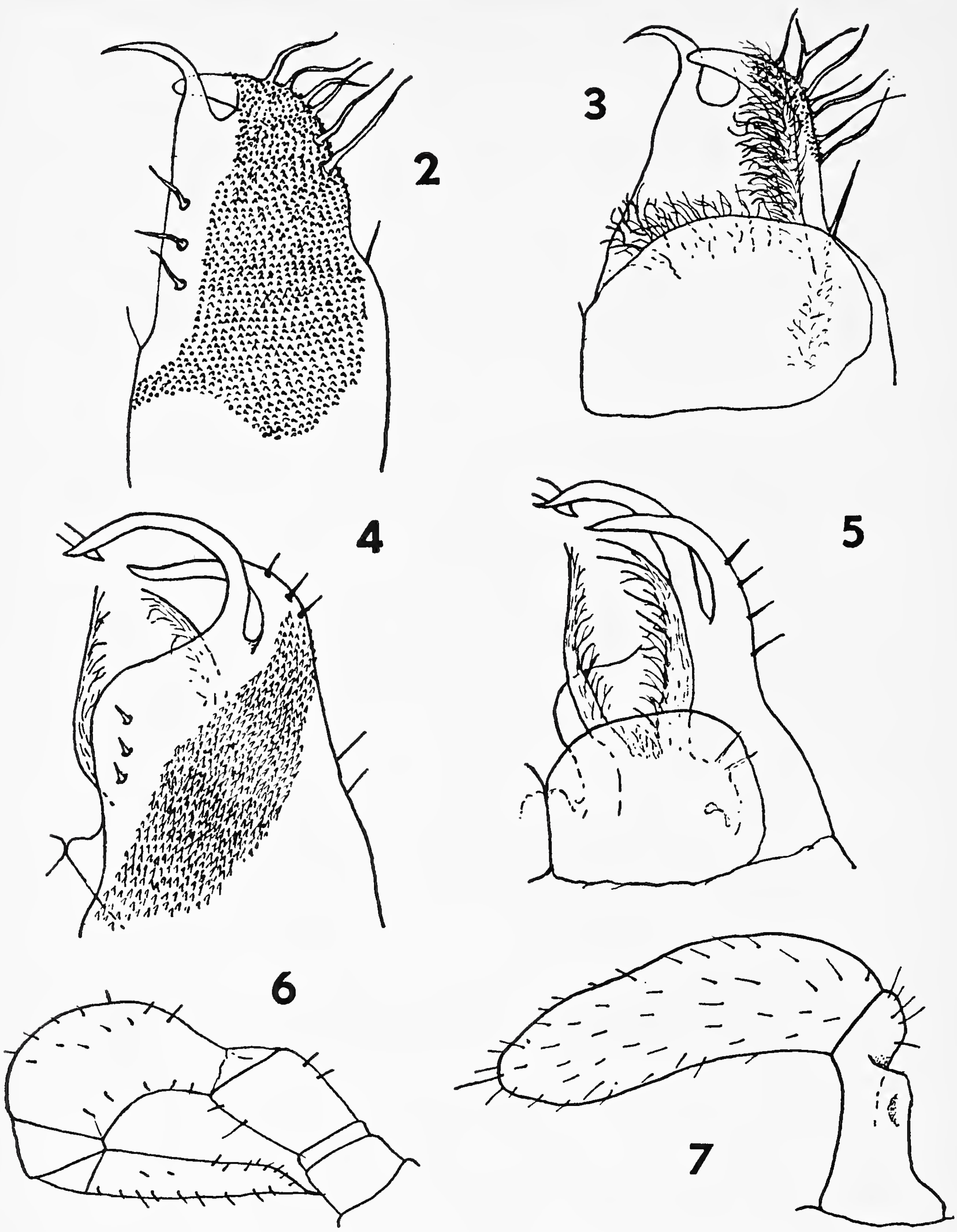
Zygonopus whitei Ryder, 1881, Proc. U. S. Nat. Mus., vol. 3, p. 527, figs. 1–3. Cook and Collins, 1895, New York Acad. Sci., vol. 9, pp. 60–62, pls. 1, 2, figs. 14–21. Loomis, 1939, Bull. Mus. Comp. Zool., vol. 86, no. 4, p. 182. Chamberlin and Hoffman (? *partim*), 1958, U. S. Natl. Mus., Bull. 212, p. 104.

Spirostrephon copei Packard. Packard, 1881, Amer. Nat., vol. 15, p. 231.

DIAGNOSIS: Distinguished by the characters of the anterior gonopod, especially the sinuous coxal setae and the two relatively short, spinous, subequal, mesially curved coxites. Very near *Z. weyeriensis,* from which it can be distinguished by the following characters of the anterior gonopod: the shorter coxites, the almost straight median margin of the coxa, and the sinuous rather than straight coxal setae.

Body length about 8 or 9 mm. The sixth legpair of the male is inflated and bowed much as in *Z. weyeriensis* (fig. 6), but the last segment is slightly plumper and bears more setae on the median surface.

Most of the anterior surface of the anterior gonopod (fig. 2) is covered with very fine, evenly spaced setae. The long setae in the median row of three and in the row of six or seven on the disto-lateral margin of the coxa are slightly sinuous and an occasional one is branched; in all other species these setae are straight and unbranched. The two coxites are not contiguous at the base; the median one is thinner and its apex is more acute than the lateral one. The telopodite, which can be seen from a pos-



Figs. 2, 3. *Zygonopus whitei* Ryder. 2. Right anterior gonopod, anterior view. 3. Left anterior gonopod, posterior view. Drawn from male topotype.

Figs. 4–7. *Zygonopus weyeriensis*, new species. 4. Right anterior gonopod, anterior view. 5. Left anterior gonopod, posterior view. 6. Sixth leg. 7. Posterior gonopod. Drawn from male holotype.

terior view of the gonopod (fig. 3), is almost ovoid; the main plumose branch is finely divided and so short that it must be viewed from a posterior view of the gonopod; the two shorter plumose branches are almost entirely covered by the telopodite.

The posterior gonopod is composed of the usual two inflated, elongated segments and a terminal spine. Except for the spine, and the larger median lobe on the first segment, the appearance is very much as in *Z. weyeriensis* (fig. 7).

Cook and Collins (1895) reported that this species has "Irregular longitudinal wrinkles" on the dorsal surface of the body. I failed to find them.

TYPE LOCALITY: Luray Cave, Page County, Virginia.

RANGE: Caves in Page and Shenandoah Counties, Virginia; and Pendleton County, West Virginia. The report by Chamberlin and Hoffman (1958) of this species in Alleghany, Bath, Montgomery, and Roanoke Counties, Virginia, undoubtedly represents an error in determination, since these counties fall within the ranges of *Z. weyeriensis* and *Z. packardi*. The Pendleton County, West Virginia, records of Loomis (1939) are based on females and should be reexamined, since *Z. weyeriensis* also occurs in this county.

RECORDS: WEST VIRGINIA: Pendleton Co. Stratosphere Balloon Cave, Aug. 31, 1958, 6 ♂, 11 ♀, T. C. Barr, Jr. This cave is 100 yards from the entrance to Seneca Caverns, from which Loomis (1939) reported *Z. whitei*.
VIRGINIA: Shenandoah Co. Madden's Cave, New Market Station, Aug. 25, 1958, 2 ♀,, T. C. Barr, Jr. Loomis (1939) identified specimens from the New Market Caves as *Z. whitei*.

Zygonopus weyeriensis, new species
Figures 4–7

Zygonopus whitei Ryder. Packard, 1883, Proc. Amer. Philos. Soc., vol. 21, pp. 194–195; 1886, Natl. Acad. Sci., vol. 4, p. 64, pl. 7, figs. 1, 1a-1o

DIAGNOSIS: Distinguished by the characters of the anterior gonopod, especially the two relatively long, spinous, subequal, mesially curved coxites. Very near. *Z. whitei*, from which it can be distinguished by the following characters of the anterior gonopod: the longer coxites, the angular median margin of the coxa, and the straight rather than sinuous coxal setae. Distinguished from *Z. packardi* by the more evenly curved and more nearly equal coxites.

DESCRIPTION OF MALE HOLOTYPE: Length 10 mm., greatest body width 0.8

mm. Legpairs three through five are slightly inflated. The sixth legpair (fig. 6) is markedly inflated and longer than any other legs.

The coxal division of the anterior gonopod (fig 4.) bears two spinous coxites, mesially curved, subequal in length and in curvature, the lateral one thicker, slightly separated at the base, and almost twice as long as the coxites of *Z. whitei*.

The coxal region is shorter than in *Z. whitei* and the median margin is broadly rounded. Most of its anterior surface is covered with minute, closely arranged, scale-like setae. Three longer, straight setae are set near the median margin and four or five on the disto-lateral margin at the base of the lateral coxite. The telopodite is relatively small, and the two sparsely divided plumose branches are almost the same length (fig. 5).

The posterior gonopod (fig. 7) is composed of two inflated, elongated segments. There is no terminal spine.

VARIATIONS: Males from other localities may differ from the holotype in the following characters: slightly smaller sixth legs, the median margin of the anterior gonopod in the form of a right angle instead of rounded, and with a minute terminal spine on the posterior gonopod.

TYPE LOCALITY: Grand Caverns, Augusta County, Virginia. This site was formerly known as Weyer's Cave.

RANGE: Caves in Augusta and Bath Counties, Virginia; and Greenbrier and Pendleton Counties, West Virginia.

RECORDS: VIRGINIA: Augusta Co.: Grand Caverns, Nov. 20, 1958, 1 ♂, 3 ♀, 2 larvae, Oscar P. Estes (type collection); Aug. 20, 1958, 2 ♂, 1 ♀, 1 larva, T. C. Barr, Jr. Madison Cave, Aug. 23, 1958, 2 larvae, T. C. Barr, Jr. Bath Co.: Breathing Cave, part of Butler Cave on Sinking Creek, Aug. 28, 1958, 6 ♂, 7 ♀, 3 larvae; Porter's Cave, Aug. 27, 1958, 1 ♂, 2 ♀, 2 larvae; Star Chapel Cave, Aug. 29, 1958, 19 specimens, T. C. Barr, Jr. WEST VIRGINIA: Greenbrier Co.: Higgenbotham Cave No. 4, Aug. 17, 1958, 8 ♂, 6 ♀, 2 larvae, T. C. Barr, Jr. Pendleton Co.: Mystic Cave, Aug. 31, 1958, 2 ♂, 2 ♀, T. C. Barr, Jr.

HISTORY: Dr. A. S. Packard made collections from Weyer's Cave in 1874 and from New Market and Luray Caves several years later. He first (1881) identified all of his specimens as *Spirostrephon copei* Packard, thinking that they were conspecific with the small white millipeds in Mammoth Cave, Kentucky. Later (1883, 1886) he changed his determination to *Zygonopus whitei,* but the description and figures that he published probably were not based on *Z. whitei.* He must have based them on his Weyer's Cave specimens, since Luray Cave is the type locality of *Z. whitei* and specimens from New Market Cave have been identified as *Z. whitei* (Loomis 1939).

He described the anterior gonopod as follows: "the outer lamina consists of a basal subtriangular portion, ending in a long, slender, curved spine, beneath which is a stouter spine, shorter and less curved; a minute median setose lamina is present, while the inner lamina is a weak, slender, setose filamentary outgrowth." The posterior gonopods were described as follows: "like those of Trichopetalum, the second (terminal) joint not ending in a claw."

Zygonopus packardi, new species
Figures 8, 9

DIAGNOSIS: Distinguished by the characters of the anterior gonopod, especially by the two spinous coxites, which are contiguous at the base and very unequal in length. Nearest *Z. weyeriensis,* from which it can be distinguished by differences in the length, position and curvature of the coxites.

DESCRIPTION OF MALE HOLOTYPE: Length about 8 mm. The fourth and seventh segments of the sixth legpair are less inflated than in *Z. weyeriensis* (fig. 6); the seventh segment is narrowed and slightly sinuous.

A band of closely placed, scale-like setae crosses the anterior surface of the coxal region of the anterior gonopod (fig. 8); the setae are coarser than in *Z. whitei.* The three longer setae in the median row and the five or six on the disto-lateral margin of the coxa are straight and about the same length as in *Z. weyeriensis.* The two coxites, which are both spinous, are very close together at the base, the longer median one overlapping the shorter, stouter, lateral one; from a lateral view there is a small gap between them. The telopodite (fig. 9) is in the form of a thick, quadrate lamella with a thinner, triangular ventral lobe. The main plumose branch is very finely divided. A second, shorter plumose branch is partly covered by the lateral margin of the telopodite.

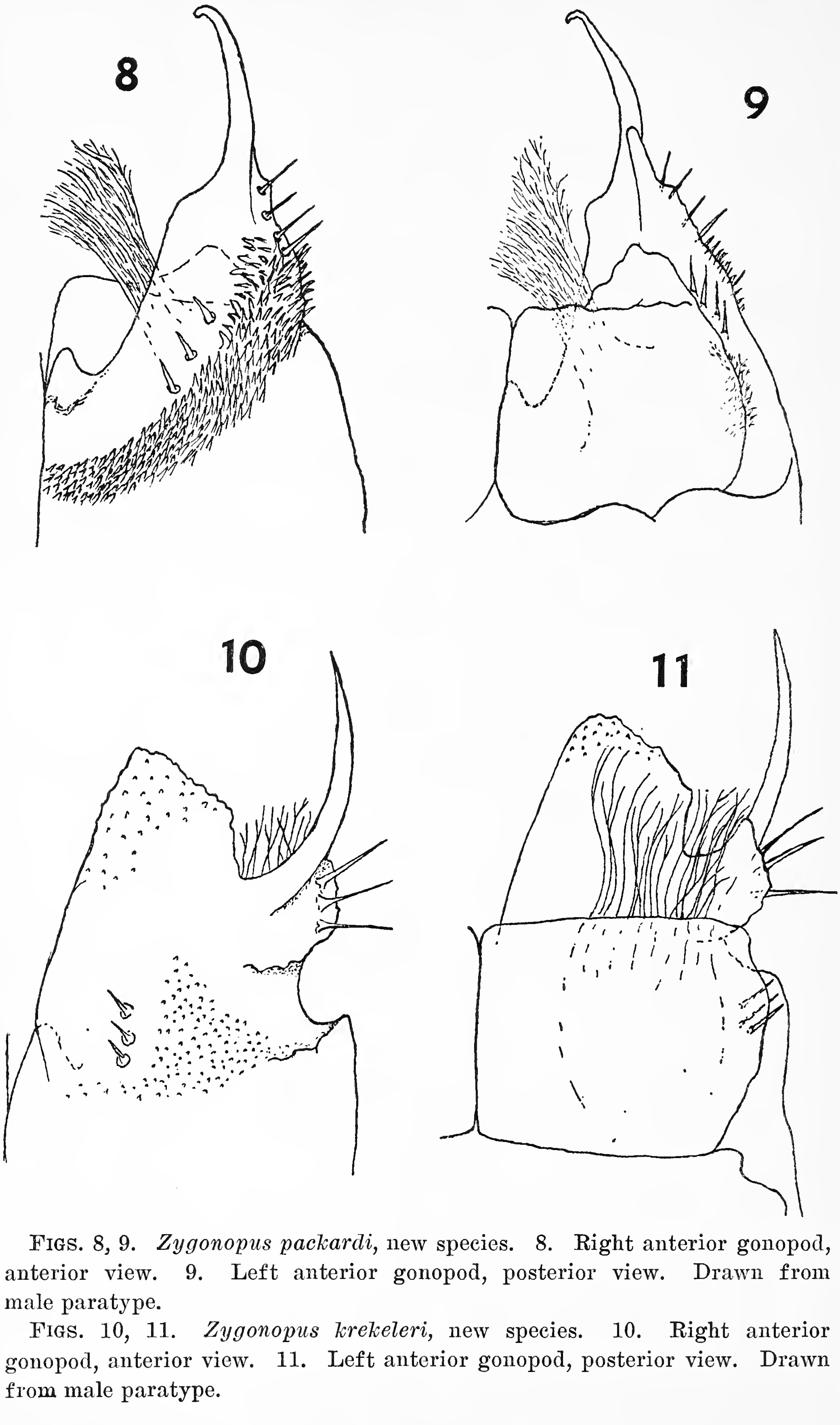
The posterior gonopod is composed of the usual two inflated, elongated segments and a minute terminal spine. The appearance is very much as in *Z. weyeriensis* (fig. 7).

VARIATIONS: Some variation was observed in the position of the coxites of the anterior gonopod, some being turned mesiad more than others; also, the shape of the triangular lobe on the ventral margin of the telopodite is slightly variable. The terminal spine of the posterior gonopod may be absent.

TYPE LOCALITY: Patton's Cave, Monroe County, West Virginia.

RANGE: Caves in Bland, Botetourt, and Giles Counties, Virginia; Greenbrier, Monroe and Mercer Counties, West Virginia; and Estill County, Kentucky. The Kentucky record may prove to be a custodial error, since no other Kentucky collections have been made.

RECORDS: VIRGINIA: Bland Co. Hamilton Cave, near Mechan-



Figs. 8, 9. *Zygonopus packardi,* new species. 8. Right anterior gonopod, anterior view. 9. Left anterior gonopod, posterior view. Drawn from male paratype.

Figs. 10, 11. *Zygonopus krekeleri,* new species. 10. Right anterior gonopod, anterior view. 11. Left anterior gonopod, posterior view. Drawn from male paratype.

icsburg, Sept. 6, 1958, 6 ♂, 7 ♀, T. C. Barr, Jr. Botetourt Co.: Perry Saltpeter Cave, at Saltpeter on the James River, Aug. 24, 1958, 3 ♂, 3 ♀, T. C. Barr, Jr. Giles Co.: Hopkins Cave, 1 mile south of Narrows, Aug. 12, 1957, 1 ♂, 1 ♀, C. H. Krekeler, Tawney Cave, 1½ mile northeast of Maybrook, Aug. 11, 1957, 1 ♂, 2 ♀. Starnes Cave, near Pearisburg, Aug. 3, 1958, 19 specimens, T. C. Barr, Jr. Straley's Cave, Sept. 6, 1958, 2 ♂, 5 ♀, T. C. Barr, Jr. WEST VIRGINIA: Greenbrier Co.: Organ Cave, Aug. 1958, 15 specimens, T. C. Barr, Jr. Mercer Co.: Honaker Cave, 5 miles southwest of Glenlyn, Virginia, Aug. 12, 1957, 1 ♂, 1 ♀, C. H. Krekeler. Monroe Co.: Fletcher's Cave, near Gap Mills, Aug. 8, 1958, 24 adult and larval specimens, T. C. Barr, Jr. Patton's Cave, 2 miles southeast of Gap Mills, Aug. 7, 1957, 5 ♂, 3 ♀, C. H. Krekeler (type collection); Aug. 8, 1958, 36 specimens, T. C. Barr, Jr.

This species is named for Dr. A. S. Packard, Jr., the founder of the science of cave biology in the United States.

Zygonopus krekeleri, new species
Figures 10, 11

DIAGNOSIS: Distinguished by the anterior gonopod, which has a broad, membranous median coxite and a longer, spinous lateral coxite.

DESCRIPTION OF MALE HOLOTYPE: Length about 8.5 mm. Fourth segment of the sixth legpair slightly more bowed and the last segment slightly thinner than in *Z. weyeriensis* (fig. 6).

The median coxite of the anterior gonopod is membranous and broad, and the lateral coxite is spinous and curved (fig. 10). A small area on the anterior surface of the coxa is covered with minute setae, and the distal part of the membranous lobe is sparsely setose. The longer setae in the median row of three and the three on the disto-lateral lobe of the coxa are straight. The telopodite (fig. 11) is in the form of a thick, quadrate lamella. The plumose branch is broad, so short that it is scarcely visible from an anterior view, and the fibrillae are sinuous and sparsely branched. A second, shorter plumose branch can be seen under the telopodite.

The posterior gonopod is composed of the usual two inflated, elongated segments; there is no terminal spine. The appearance is very much as in *Z. weyeriensis* (fig. 7).

TYPE LOCALITY: Alpena Cave No. 1, Alpena, Randolph County, West Virginia.

RANGE: Caves in Randolph and Tucker Counties, West Virginia.

RECORDS: WEST VIRGINIA: Randolph Co.: Alpena Cave No. 1,

Alpena, July 20, 1957, 8 ♂, 9 ♀, C. H. Krekeler (type collection). Tucker Co.: Bennett Cave, 2 miles northeast of Gladwin, July 20, 1957, 2 ♂, 3 ♀, C. H. Krekeler.

It is a pleasure to name this species for Dr. Carl H. Krekeler.

RECORDS OF COLLECTIONS OF *Zygonopus* WITHOUT MATURE MALES:

WEST VIRGINIA: Greenbrier Co.: Pollock Caves, 3½ miles north-northeast of Alderson, Aug. 10, 1957, larvae, C. H. Krekeler. Monroe Co.: Argobrita Cave, 3 miles southeast of Wolf Creek, Aug. 10, 1957, 2 ♀, C. H. Krekeler. Pocahontas Co.: Martha Clark's Cave, near Marlinton, Aug. 15, 1958, 1 fragment, T. C. Barr, Jr. Randolph Co.: Crawford Cave, 3½ miles southwest of Valley Head, July 23, 1957, 2 ♀, C. H. Krekeler.

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NOTE ON COLONY SIZE AND ACTIVITY IN POGONOMYRMEX OCCIDENTALIS (CRESSON)*

The colonies studied were located on the floodplain of Cave Creek at the Southwestern Research Station, 5 miles SW of Portal, Arizona. This site is at an elevation of 5400′ in an oak-pine woodland. One colony was excavated Feb. 26–29, 1959, just after colony activity began in the spring. The ants were placed in alcohol as they were uncovered and their numbers were estimated later by measuring the packed volume of all ants and counting the number of individuals in several 100 ml. samples. The number of foraging workers was estimated for four other colonies in Sept. and Oct. 1958 and July 1959, using the mark-release-recapture method (Chew, 1959. Jour. N. Y. Ent. Soc., **67**, 3, 4).

EXCAVATED COLONY. A total of 8700 ants was collected. If the size of the surface mound is a reliable index of colony size, 8700 ants would be about average for colones of *P. occidentalis* in the area studied. The ants were found in clusters of 100–500 at successively deeper levels. The last workers were found at a depth of 5½′, which was at the beginning of the C horizon in the soil profile. The queen was not found. The diameter of the area occupied by the colony did not exceed 2½′.

No pupae, larvae or eggs were found and fewer than 100 individuals appearing to be callows were taken (all in the upper foot of digging). Apparently *P. occidentalis* does not carry brood through the winter in this area. There were six caches of seeds, totalling about 175 ml. volume. The seeds were principally those of the telegraph weed, *Heterotheca subaxilaris;* about 5 percent were sprouting when found underground.

FORAGING WORKERS. On Feb. 25 the number of foraging ants was estimated as 248 in the colony to be excavated. As is to be expected, activity of the colony is achieved only slowly in the spring; apparently the ants in the upper part of the colony are warmed and become active first.

* Contribution from the Southwestern Research Station of the American Museum of Natural History, Portal, Arizona.

Estimates of foraging workers in four adjacent colonies, of about the same mound size as the excavated colony, ranged from 1500 to 4800 per colony in July, Sept. and October, as compared to a total of 8700 workers in the excavated colony.

In two other colonies, foraging workers were estimated at 525 and 1200 in July. Following this census, workers were removed daily from the surface around each mound for 5 days. After removal of 1029 individuals there was practically no outside activity at the first mound, but this may partly have been due to very wet weather in the last two days of the removal procedure. Removal of 1265 ants from the second nest did not noticeably reduce the number of foraging individuals.

These limited data suggest that for *P. occidentalis* in the area studied, no more than half the workers in a colony are active in foraging outside at any one time, even at the height of seasonal activity. However, many more data are needed before a reliable conclusion can be drawn.—Robert M. Chew, *Dept. Biology, Univ. Southern California, Los Angeles.*

THE TEPHRITIDAE AND OTITIDAE OF THE BAHAMA ISLANDS (DIPTERA)

By RICHARD H. FOOTE
ENTOMOLOGY RESEARCH DIVISION, ARS,
UNITED STATES DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

The purpose of the present paper is to record a series of Tephritidae and Otitidae collected by the Van Voast-American Museum of Natural History expedition to the Bahama Islands in 1952 and 1953, and to present a complete list of the species in each of these two families so far known to occur, or likely to be found, in the Bahamas.

Of the 17 species of Tephritidae discussed herein, 2 are new to science, 2 have been recorded only from Florida, 2 have a purely Nearctic distribution, 10 are distributed widely over North, Central, and South America and the West Indies, and 1 is a typical South American species. Only 5 have previously been reported from the Bahama Islands. Benjamin (U. S. Dept. Agric. Tech. Bull. No. 401, 1934) discusses in some detail the nomenclature, morphological characters, and distribution of 11 of these tephritids; his paper is drawn upon heavily for data contained herein.

Nine of the 15 species of Otitidae occurring in the Bahamas have been recorded from Florida; all but 1 of these also occur in other states. Five species have purely West Indian, Central or South American distributions, and one is described as new. Only two of the 15 species have been previously recorded from the Bahamas. The absence of distribution records in this family in many cases is probably a reflection of lack of intensive study. Curran (Amer. Mus. Novit. No. 812, 1935) has furnished the most recent key to the species of the genus *Euxesta*. There is no recent revisionary work devoted to the family Otitidae as a whole in the Americas.

The list of Johnson (Psyche **15**: 69–80, 1908) has long served as the only guide to the Diptera occurring in the Bahamas; all 1904 records in this paper are quoted from his list. Knab and Yothers' (Jour. Agric. Res. 2 (6): 447–453, 1914) Bahama rec-

ord of *Toxotrypana curvicauda* Gerst. is the only addition to these two families known to me. It is rather surprising that the study of the faunas of these two families has been neglected to such an extent on this island chain.

In the following treatment the first synonymical reference for each species is to the original description; other entries are limited to the more important sources of information about the taxonomy of the species concerned and to its occurrence in the Bahamas. Nearly all specimens seen in this study, unless otherwise noted, were collected by E. B. Hayden, G. B. Rabb, and L. Giovannoli. Most of the material, including holotypes and some paratypes of each of the new species, has been deposited in the American Museum of Natural History.

I wish to extend thanks to Dr. Mont A. Cazier and Dr. C. H. Curran, American Museum of Natural History, for providing the bulk of the material for study, and to Mr. George Steyskal for his advice on *Euxesta luteocesta,* n. sp.

The "Distribution" portion of each species treatment includes records available from the literature or available elsewhere previous to the Expedition, as well as those received from the American Museum of Natural History for identification.

Family TEPHRITIDAE

Toxotrypana curvicauda Gerstäcker

Toxotrypana curvicauda Gerstäcker, 1860, Ent. Ztg. Stettin 21 (46): 194, pl. 2; Knab and Yothers, 1914, Jour. Agr. Res. 2 (6): 447 *et seq.*, pl. 41, figs. 1 and 2; pl. 42, figs. 1–4.

DISTRIBUTION.—No material was collected from this study. The species has been previously recorded from New Providence, where it was reared from papaya by Knab and Yothers.

This distinctive species has a very wide distribution in tropical America which probably coincides with its host plant, *Carica papaya* L. Aczél (Acta Zool. Lilloana 7: 181, 1949) lists the following localities from which the species has been recorded: St. John, Antigua (an error repeated again and again in the literature; it refers to the island of St. Jean, Danish West Indies, according to Knab and Yothers); Bahamas (see below); Puerto Rico; Mexico (Yucatan); Costa Rica; Peru; Brazil; United States (South Carolina, Florida, Texas).

Genus *Anastrepha* Schiner

No species of *Anastrepha* have ever been recorded from the Bahama Islands. There is a possibility, however, that *mombinpraeoptans* Seín may actually occur and that its presence has remained undetected because collecting dates have not coincided with peaks of abundance, or because fruit has rarely been carefully investigated. *A. mombinpraeoptans* occurs throughout the Greater and Lesser Antilles and in Florida.

Two other species occurring in Florida but having more restricted distribution in the West Indies are *suspensa* (Loew) and *ocresia* (Walker). These are less likely to occur in the Bahamas than is *mombinpraeoptans*, but the possibility does exist and should be taken into account during future entomological exploration of these islands.

Xanthaciura connexionis Benjamin

Xanthaciura connexionis Benjamin, 1934, U. S. Dept. Agric. Tech. Bull. No. 401: 45; fig. 32.

DISTRIBUTION.—Abaco Cays: 2 ♂♂, 1 ♀, Allen's Cay, 9 May 1953; 1 ♀, Great Sale Cay, 10 May 1953; 5 ♂♂, 2 ♀♀, Bennett's Harbor, Cat Island, 24 March 1953; 1 ♂, Landrail Point, Crooked Island, 5 March 1953; Eleuthera Island: 1 ♂, Governor's Harbor, 31 March 1953; 2 ♂♂, New Portsmouth (Rock Sound). 28 March 1953; 1 ♂, Fish Cay (south of Fortune Isl. or Long Cay); 8 March 1953; 1 ♂, Eight-mile Rock, Grand Bahamas Island; 14 May 1953; 1 ♂, 1 ♀, Marsh Harbor, Great Abaco Island; 6 May 1953; 1 ♀, near Abraham Bay, Mayaguana Island; 3 March 1953; New Providence Island: 1 ♀, Nassau, 16 April 1953; 1 ♀, 2 mi. E. Nassau, 14 April 1953.

This species is present throughout southern Florida, and especially abundant in the southern tip of that state.

Xanthaciura insecta (Loew)

Trypeta insecta Loew, 1862, Smiths. Misc. Collect. 6 (1) : 72; Tab. III, fig. 8.

Aciura insecta; Johnson, 1908, Psyche 15: 78.

Xanthaciura insecta; Benjamin, 1934, U. S. Dept. Agric. Tech. Bull. No. 401: 44; fig. 31.

DISTRIBUTION.—8 ♂♂, 1 ♀, Allan's Cay, Abaco Cays; 9 May

1953; Andros Island: 1 ♂, 1 ♀, Fresh Creek; 23 April 1953; 2 ♀♀, Mangrove Cay, 19 June 1924 (C. E. Olson); Berry Islands: 2 ♂♂, 2 ♀♀, Frazier's Hog Cay, 30 April 1953; 16 ♂♂, 21 ♀♀, Little Harbor Cay, 1 May 1953; Eleuthera Island: 2 ♀♀, Hatchet Bay (near Alicetown), 2 April 1953; 12 ♂♂, 6 ♀♀, Governor's Harbor, 31 March 1953; 1 ♂, 1 ♀, New Portsmouth (Rock Sound), 28 March 1953; Grand Bahamas Island: 1 ♂, Pine Ridge (at light), 13 May 1953; 5 ♂♂, 3 ♀♀, West End, 12 May 1953; 10 ♂♂, 12 ♀♀, Marsh Harbor, Great Abaco Island; 6 May 1953; New Providence Island: 11 ♂♂, 5 ♀♀, Nassau, 16 April 1953; 4 ♂♂, 4 ♀♀, 2 mi. E. Nassau, 14 April 1953; 1 ♂, 5 mi. W. Nassau, 6 April 1953; 3 ♂♂, near Windsor Field, 12 April 1953; 1 ♀, near Cockburn Town, San Salvador Island; 18 March 1953; 2 ♀♀, So. Bimini Island; 20 August 1951 (C. & P. Vaurie). Previously recorded from United States (Florida), Bermuda, Jamaica, Cuba, Puerto Rico, Mexico, Costa Rica, Honduras, and Mangrove Cay, Andros Island (1 August 1904).

DISCUSSION.—The specimens seen in this study agree very well with Benjamin's excellent description and illustrations. The distal spot in the first posterior cell varies in shape and is rarely completely round. In every specimen I have examined, the fourth hyaline spot (counted from the wing base) on the posterior margin of the wing is fainter than any of the others in the row.

Xanthaciura tetraspina (Phillips)

Aciura (*Eucosmoptera*) *tetraspina* Phillips, 1923, Jour. N. Y. Ent. Soc. 31: 132.

Xanthaciura tetraspina; Benjamin, 1934, U. S. Dept. Agric. Tech. Bull. 401: 46; fig. 33.

DISTRIBUTION.—1 ♂, nr. Abraham Bay, Mayaguana Island, 3 March 1953.

Previously recorded from Missouri, Indiana, Texas, and Florida (south to Orlando).

Acinia fucata (Fabricius)

Musca fucata Fabricius, 1792, Ent. Syst., p. 359.

Acinia fucata; Benjamin, 1934, U. S. Dept. Agric. Tech. Bull. No. 401: 48; fig. 34.

DISTRIBUTION.—4 ♀♀, 4 ♂♂, Nassau, New Providence Island,

June, 1956 (N. L. H. Krauss); 1 ♀, near Cockburn Town, San Salvador Island; 18 March 1953.

The species occurs in North, Central, and South America, and the West Indies. In the United States it ranges from New Jersey to Florida (Jacksonville to Key West).

Acrotaenia trisignata, new species
(Figure 1)

A greyish yellow pollinose species. The wing has only three black costal spots, the basal one occupying the entire stigma. Ill-defined triangular hyaline incisions are present on the apical third of the wing posteriorly.

FEMALE. Head yellowish except for eyes, which are black, and a very small dark spot between eye and base of antenna. Eye 0.85 times as high as head; frons at vertex about 1.6 times as wide as one eye, frons widening only very slightly from vertex to frontal suture; face concave and projecting forward sharply just below tip of third antennal segment. Inner and outer verticals, postoculars, posterior upper frontoorbitals, cheek setae and cheek bristle yellowish-white; ocellars, anterior pair of upper frontoorbitals and all lower frontoorbitals dark brown; inner verticals, upper and lower frontoorbitals all in a line parallel with inner border of eye. Antenna yellow, apex of third segment rounded; arista rather stout and yellow on basal fourth, distal three-fourths comparatively slender, dark brown.

Mesonotum heavily grey pollinose with five long, faintly differentiated yellowish pollinose stripes extending from front of prescutellum, the middle three stripes nearly attaining scutellum; pleura, sternum, and scutellum heavily pollinose; dorsocentrals very close to the suture and situated on the outer borders of the grey areas adjacent to central stripe; achrosticals situated in the centers of these grey areas; scutellum heavily grey pollinose; two pairs of scutellars, the apical pair about 0.8 times as long as basal; presutural, anterior supraalar, postalar, dorsocentral, achrostical and scutellars each arising from a distinct black spot. Anterior coxa yellowish pollinose and some pollinosity on other coxae, remainder of legs uniformly shining yellow except for a small, ill-defined brownish spot on ventral surfaces of mid and hind femora.

Wing (fig. 1) with three large black spots on costa, and basal spot extending through stigma to second vein, the middle spot somewhat exceeding second vein, the distal spot confined to the marginal cell; area of small hyaline spots on wing disc extending along costa halfway from distal black spot to end of second vein, and terminated across outer third of wing by a narrow but more or less continuous hyaline area; an additional narrow hyaline area extending from posterior border well into first posterior cell just distad of posterior crossvein. Halter pale yellow.

Abdomen yellow pollinose, approximately the same color as mesonotum, tergites II, III, and IV each with an ill-defined brown spot on each side of center line; sternites concolorous with tergites; ovipositor sheath glistening brownish yellow, distinctly browner on basal third than on apical two-

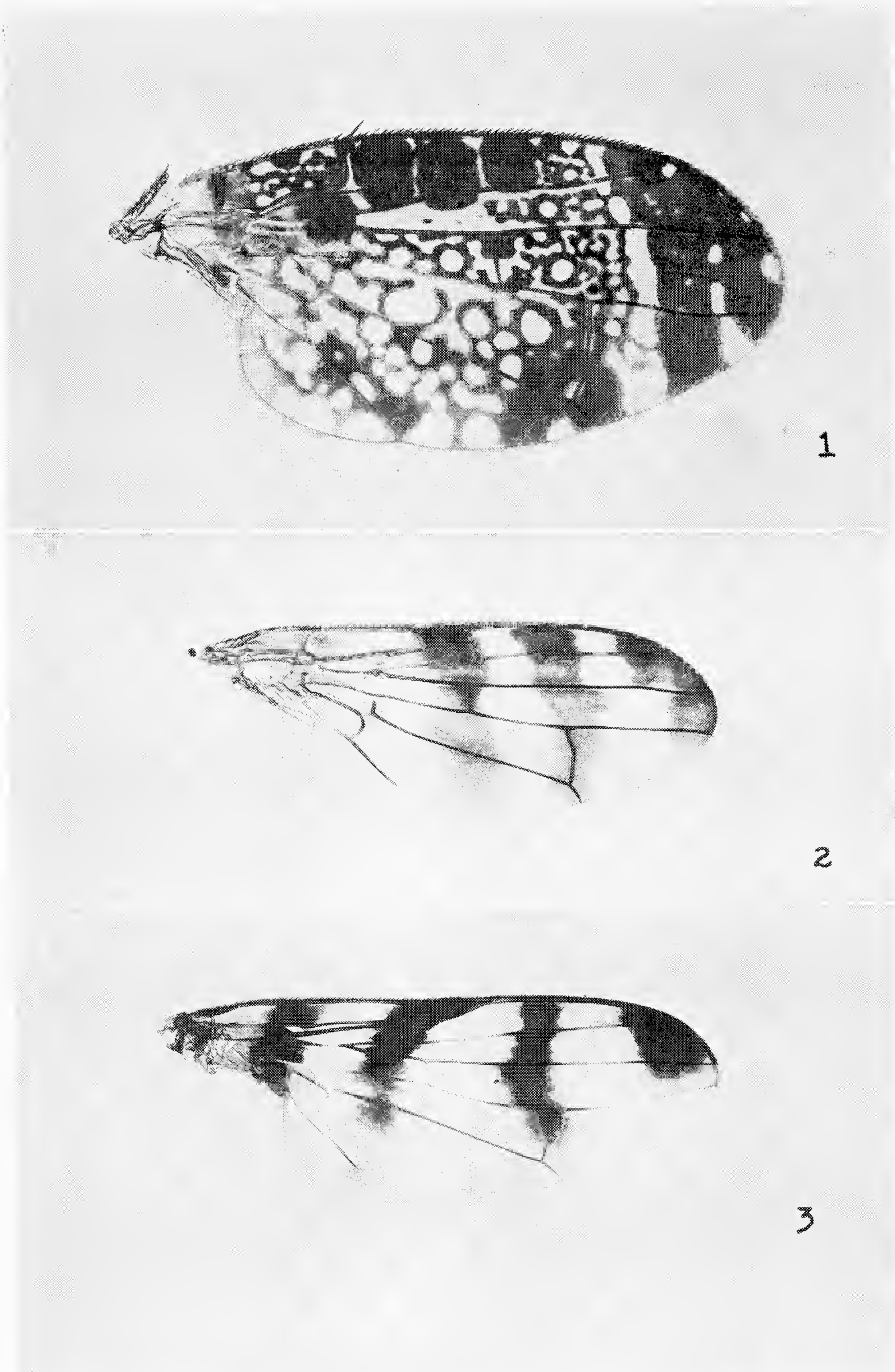

FIG. 1. Wing of *Acrotaenia trisignata*. FIG. 2. Wing of *Urophora trivirgulata*. FIG. 3. Wing of *Euxesta luteocesta*.

thirds, the extreme tip black; ovipositor brownish yellow, approximately 1.6 times as long as sheath (estimated from partially infolded position).

MALE. Unknown.

TYPE.—Holotype ♀, Fresh Creek, Andros Island, Bahamas Islands, 23 April 1953, E. B. Hayden and L. Giovannoli, collectors.

DISCUSSION.—There is no doubt that this female belongs to a new species because it is so easily distinguished from the other two New World *Acrotoxa* with large, distinct black costal spots, *otopappi* Doane and *testudinea* Loew. *A. otopappi* has at least four dark costal spots, two of which lie within the stigma, and the light spot at the end of the second vein attains the third vein. *A. trisignata* is alone in having a single, well-defined hyaline area on the posterior apical third of the wing. *A. otopappi* appears to be restricted to Mexico, while *testudinea* inhabits the westernmost islands of the West Indies.

Icterica atacta Hendel

Icterica atacta Hendel, 1914, Abh. Ber. Konigl. Zool. Anthrop.-Ethnogr. Mus. Dresden 14: 62; Pl. 3, fig. 51.

DISTRIBUTION.—1 ♀, 2 mi. E. Nassau, New Providence Island; 14 April 1953.

The species has also been recorded from Paraguay.

DISCUSSION.—Obviously a rare species, since most workers refer to Hendel's original description without adding new locality records.

Urophora trivirgulata, new species
(Figure 2)

Easily distinguished from all known species in the genus by the presence of only three dark transverse bands on the wing.

FEMALE.—Head yellow except for eyes and ocellar triangle, which are black; lunule, antennae and face distinctly lighter yellow than front or cheeks. Eye 0.6 times as high as head; front at vertex 1.4 times as wide as one eye, parallel-sided from vertex to frontal suture; face depressed rather deeply on each side of center line to form an antennal fovea; cheek very wide and irregularly roughened. All head hairs black; one pair of upper frontoorbitals, two or three pairs of lower frontoorbitals with fine but well differentiated hairs between them but in the same line, and in line with upper frontoorbital. Third antennal segment rounded apically. Mouth parts yellow, geniculate, the labellar portion one-half as long as head.

Mesonotum black pollinose, entire surface covered by short, slender black hairs, dorsocentrals in an imaginary line extending between the supraalars;

pleura mostly black pollinose but somewhat shiny, as is the scutellum; a narrow line along the dorsal margin of mesopleuron and lower half of humeral callus yellow; scutellum black and much more lightly pollinose than mesonotum; two pairs of scutellars, all about the same length. Mid and hind coxae lightly black pollinose over a yellow ground color, fore coxae and remaining portions of all legs entirely yellow.

Base of wing (fig. 2) hyaline, three dark bands at right angles to the longitudinal axis of the wing; the proximal of these nearly filling the stigma, enclosing the anterior crossvein, and continuing to the posterior margin; second band parallel with the proximal, separated from it by a hyaline area as wide as the proximal band, unbroken from costa to posterior wing margin and enclosing the posterior crossvein; distal band lying diagonally across wing apex, with an irregular inner margin extending from a point on costa anterior to end of second vein to a point on posterior border about one-third the distance between terminations of fourth and fifth veins; middle and apical bands completely separated in all except one male, in which they are joined in marginal cell. Halter light yellow.

Abdominal tergites I, II and III the same color and density of pollinosity as the mesonotum, tergites IV and V somewhat blackish pollinose, but with the suggestion of a metallic green tinge which is absent in the preceding tergites; sternites with the same pollinosity and color as the thoracic pleural sclerites; ovipositor sheath about as long as tergites I through VI taken together, broad at base, tapering to a rather narrow tube at mid-point, the distal half parallel-sided.

MALE.—As in female with the exception of the usual sexual differences. Tergites of abdominal segments I, II and III as in female; tergite of segment IV as long as the first three combined, with metallic green reflections as in the female, subshining; tergite of segment V shining black.

Types.—Holotype ♀, Great Sale Cay, Abaco Cays, Bahama Islands, 10 May 1953, E. B. Hayden and G. B. Rabb, collectors. Paratypes: 4 ♂♂, 1♀, same data as holotype; 1 ♂, 1 ♀ paratype retained in the collection of the U. S. National Museum.

Dioxyna picciola (Bigot)

Acinia picciola Bigot, 1857, in Sagra, Hist. Fis., Pol. and Nat. Cuba, 2nd Pt., Hist. Nat., 1856, 7: 347; pl. 20, fig. 10.

Ensina picciola; Johnson, 1908, Psyche 15: 78.

Paroxyna picciola; Benjamin, 1934, U. S. Dept. Agric. Tech. Bull. No. 401: 42; fig. 30.

Dioxyna picciola; Munro, 1957, Ruwenzori Exped., 1934–35, Brit. Mus. 2 (9): 937; figs. 51, 52, 53f.

DISTRIBUTION.—Abaco Cays: 72 ♂♂, 40 ♀♀, Allen's Cay, 9 May 1953; 21 ♂♂, 20 ♀♀, Elbow Cay, Hope Town, 4 May 1953; Andros

Island; 43 ♂♂, 16 ♀♀, Fresh Creek, 23 April 1953; 18 ♂♂, 4 ♀♀, Lisbon Creek (near South Bight), 28 April 1953; 8 ♂♂, 4 ♀♀, Mangrove Cay, 26 April 1953; Berry Islands: 36 ♂♂, 23 ♀♀, Frazier's Hog Cay, 30 April 1953; 67 ♂♂, 29 ♀♀, Little Harbor Cay, 1 May 1953; 1 ♂, The Bight, Cat Island, 22 March 1953; Eleuthera Island: 40 ♂♂, 30 ♀♀, Governor's Harbor, 31 March 1953; 37 ♂♂, 31 ♀♀, Hatchet Bay (near Alicetown), 2 April 1953; 46 ♂♂, 20 ♀♀, James Cistern, 1 April 1953; 38 ♂♂, 19 ♀♀, New Portsmouth (Rock Sound), 28 March 1953; Exuma Cays: 1 ♂, Big Farmer's Cay, 13 January 1953; 1 ♂, Darby Island, 18 January 1953; 5 ♂♂, Little Farmer's Cay, 17 January 1953; Grand Bahamas Island: 8 ♂♂, 7 ♀♀, Pine Ridge (at light), 13 May 1953; 30 ♂♂, 31 ♀♀, West End, 12 May 1953; 71 ♂♂, 34 ♀♀, Marsh Harbor, Great Abaco Island; 6 May 1953; Long Island: 1 ♂, Clarence Town, 13 March, 1953; 1 ♂, Deadman's Cay, 11 March 1953; 3 ♂♂, 5 ♀♀, near Abraham Cay, Mayaguana Island; 3 March 1953; New Providence Island: 42 ♂♂, 23 ♀♀, Nassau, 16 April 1953; 82 ♂♂, 38 ♀♀, 2 mi. E. Nassau, 14 April 1953; 5 ♂♂, 4 ♀♀, 5 mi. W. Nassau, 6 April 1953; 10 ♂♂, 3 ♀♀, near Windsor Field, 12 April 1953; North Bimini Island: 11 ♂♂, 7 ♀♀, Alicetown, 30 December 1952; 2 ♂♂, Hatchet Bay (near Alicetown), 2 April 1955; 10 ♂♂, 3 ♀♀, near Port Nelson, Rum Cay; 16 March 1953; 4 ♂♂, 2 ♀♀, near Cockburn Town, San Salvador Island; 18 March 1953; 3 ♀♀, South Bimini Island; 20 August 1951 (C. & P. Vaurie); 1 ♂, Grand Turk Island, 19 February 1953.

This widespread species has been collected from many localities in the West Indies and is the most frequently encountered Nearctic member of the genus. It is by far the most common tephritid in this study.

DISCUSSION.—Benjamin has adequately described and figured the species. However, some of the specimens seen in this study differ from that illustrated by Benjamin in that the distal spot in the marginal cell varies greatly in size and position. In some of them this spot is entirely absent, in some it is fused with the middle spot, and in others, it is separate and very small. I have seen many combinations in the specimens before me.

Hardy and Adachi have adopted the name *Stylia* Robineau-Desvoidy, 1830, for this genus. Dr. E. M. Hering (1954, Bonner Zoologisches Beiträge, 5: 167) designated *bidentis*, an originally

included species as type of *Stylia* and indicated that the name *Paroxyna* is a synonym. It is the feeling of Dr. H. K. Munro (*in litt.*) who has examined specimens of *bidentis,* that Robineau-Desvoidy had in mind a *Myopites* rather than a *Paroxyna* concept. I prefer to retain the name *Paroxyna* until the matter is settled by those to whom the Robineau-Desvoidy specimens are available for examination. Munro, in 1957, revised the genus and clarified many records of this species formerly attributed to *sororcula* (Wied.)

Euaresta bella (Lowe)

Trypeta bella Loew, 1862, Smiths. Misc. Collect. 6 (1): 88.
Euaresta bella; Johnson, 1908, Psyche 15: 78; Benjamin, 1934, U. S. Dept. Agric. Tech. Bull. No. 401: 50, fig. 35; Quisenberry, 1950, Jour. N. Y. Ent. Soc. 58: 34, figs. 2B, 3G and 3J.

DISTRIBUTION.—4 ♂♂, 1 ♀, Nassau, New Providence Island; 16 April 1953; previously reported from Andros Island (Mangrove Cay) and New Providence Island (Nassau) (4 specimens, 28 June and 1 August 1904).

This is the most widespread member of the genus in North America, having been recorded in the United States from 29 States and the District of Columbia. It also occurs in Canada and Mexico.

DISCUSSION.—Benjamin and Quisenberry have adequately described and discussed the morphological features of this species.

Dyseuaresta mexicana (Wiedmann)

Trypeta mexicana Wiedemann, 1830, Auss. Zweifl. Ins. II: 511.
Euaresta melanogaster (Loew); Johnson, 1908, Psyche 15: 78.
Dyseuaresta mexicana; Benjamin, 1934, U. S. Dept. Agric. Tech. Bull. No. 401: 51; fig. 36.

DISTRIBUTION.—2 ♂♂, 1 ♀, Allen's Cay, Abaco Cays; 9 May 1953; 2 ♂♂, Mangrove Cay, Andros Island; 26 April 1953; 3 ♂♂ 1 ♀, Little Harbor Cay, Berry Islands; 1 May 1953; Cat Island: 1 ♀, Bennett's Harbour, 24 March 1953; 1 ♂, 1 ♀, The Bight, 22 March 1953; 1 ♀, McQueen, 23 January 1953; Eleuthera Island: 17 ♂♂, 7 ♀♀, Governor's Harbor, 31 March 1953; 1 ♀, James Cistern, 1 April 1953; 7 ♂♂, 5 ♀♀, New Portsmouth (Rock Sound), 28 March 1953; 1 ♂, West End, Grand Bahama Island; 12 May 1953; Long Island: 1 ♀, Clarence Town, 13 March 1953;

3 ♂♂, 1 ♀, Deadman's Cay, 11 March 1953; 16 ♂♂, 12 ♀♀, Alicetown, North Bimini Island; 30 December 1952; New Providence Island: 1 ♀, Nassau, 16 April 1953; 10 ♂♂, 9 ♀♀, Nassau, 5 May 1953; 4 ♂♂, 2 mi. E. Nassau, 14 April 1953; 2 ♂♂, 7 ♀♀, South Bimini Island; 20 August 1951 (C. & P. Vaurie).

This species occurs in the United States from Texas to Florida and has been collected in Mexico, St. Vincent, Puerto Rico, Cuba, Venezuela, and Paraguay.

DISCUSSION.—Benjamin has adequately described and figured this species. The genus may be distinguished from North American species of the genus *Euaresta,* which it closely resembles, by the single pair of scutellars inserted near the base of the scutellum and by the absence of striations on the distal surfaces of the male claspers.

Trupanea actinobola (Loew)

Trypeta actinobola Loew, 1873, Smiths. Misc. Collect. 11 (256): 326; ibid., p. 330, assigned to the genus *Urellia.*

Trupanea (*Trupanea*) *actinobola;* Benjamin, 1934, U. S. Dept. Agric. Tech. Bull. No. 401: 56; fig. 41.

DISTRIBUTION.—1 ♂, Pine Ridge, Grand Bahama Island; 13 May 1953.

Inhabits the eastern United States and occurs in Texas and California.

DISCUSSION.—Although Benjamin regards *actinobola* as a species complex, the single specimen from the Bahamas agrees well with the Florida material seen and described by him. The Texas and California records cited by him may prove to belong to one or more different species.

Trupanea dacetoptera Phillips

Trypanea dacetoptera Phillips, 1923, Jour. N. Y. Ent. Soc. 31: 148, fig. 59; Malloch, 1942, Proc. U. S. Nat. Mus. 92 (3133): 14, fig. 1t.

Trupanea (*Trupanea*) *dacetoptera;* Benjamin, 1934, U. S. Dept. Agric. Tech. Bull. No. 401: 54; fig. 38.

DISTRIBUTION.—1 ♀, New Portsmouth (Rock Sound), Eleuthera Island; 28 March 1953; 2 ♀♀, South Caicos Island, 11 February 1953. Previously known only from Orlando, Florida.

DISCUSSION.—The three females seen in this study lack the connecting dark mark, or suggestion of it, shown by Benjamin,

Malloch, and Phillips to extend horizontally between the two dark marks in the discal cell. There is a distinct, rounded dark spot on the middle of the fifth vein.

Neotephritis abstersa (Loew)

Trypeta abstersa Loew, 1862, Dipt. Amer. Sept. Ind., Cent. II, p. 91 *in* Berl. Ent. Zeitschr. 6: 221.

Trupanea (*Euarestoides*) *abstersa;* Benjamin, 1934, U. S. Dept. Agr. Tech. Bull. No. 401: 58, fig. 43.

DISTRIBUTION.—1 ♂, Allen's Cay, Abaco Cays; 9 May 1953; 1 ♂, Drigg's Hill (near South Bight), Andros Island; 27 April 1953; 1 ♀, Frazier's Hog Cay, Berry Islands; 30 April 1953; 1 ♂, Bennett's Harbour, Cat Island, 24 March 1953; 1 ♂, Landrail Point, Crooked Island; 5 March 1953; 1 ♂, Warderick Wells Cay, Exuma Cays; 10 January 1953; 1 ♀, Matthew Town, Great Inagua Island; 31 January 1953; 1 ♀, Nassau, New Providence Island; 16 April 1953; 1 ♂, 1 ♀, Long Cay (so. of South Caicos Island), 10 February 1953; 1 ♂, Cays 3.5 mi. S.W. of North Caicos Island, 28 February 1953; 1 ♀, South Caicos Island, 11 February 1953.

Recorded from New England, Florida and Texas.

DISCUSSION.—Although slightly smaller than the Florida specimens in the collection of the U. S. National Museum, those seen in this study agree well with the description given by Benjamin, and the wing markings are fully as distinct as those in the Florida material.

Family OTITIDAE

Euxesta abdominalis Loew

Euxesta abdominalis Loew, 1867, Berl. Ent. Zeitschr. 11: 307, pl. 2, fig. 15; Johnson, 1908, Psyche 15: 78; Curran, 1935, Amer. Mus. Novit., No. 812, p. 10 (in key only).

DISTRIBUTION.—Alicetown, North Bimini Island; 1 ♂ July, 1951 (C. & P. Vaurie); 1 ♀, 30 December 1952; 2 ♂♂, South Bimini Island, June 1951 (C. & P. Vaurie).

Previously recorded from Nassau, New Providence Isl., 28 June 1904, and commonly encountered in Central America and the West Indies.

Euxesta annonae (Fabricius)

Musca annonae Fabricius, 1794, Ent. Syst. Ins. IV: 358.

Euxesta annonae; Johnson, 1908, Psyche 15: 78; Curran, 1935, Amer. Mus. Novit., No. 812, pp. 11 (in key only).

DISTRIBUTION.—Previously reported from Mangrove Cay, Andros Island, 1 August 1904. Widely distributed in South America and the West Indies, and occurs in Florida.

Euxesta basalis (Walker)

Ortalis basalis Walker, 1852, Ins. Saund., p. 373.

DISTRIBUTION.—1 ♂, South Bimini Island, July 1951 (Cazier & Gertsch). The species also occurs in Georgia and Florida.

Euxesta juncta Coquillett

Euxesta juncta Coquillet, 1899, Proc. Ent. Soc. Wash. 6: 95; Curran, 1935, Amer. Mus. Novit., No. 812, p. 10 (in key only).

DISTRIBUTION.—4 ♀♀, New Portsmouth (Rock Sound, Eleuthera Island; 28 March 1953; 1 ♀, West End, Grand Bahama Island; 12 May 1953; 3 ♀♀, Marsh Harbor, Great Abaco Island; 6 May 1953; 1 ♀, 5 mi. W. Nassau, New Providence Island; 6 April 1953. Previously known only from Nicaragua and Peru.

DISCUSSION.—This species possesses two light spots on the distal half of the wing, a rather unusual pattern for species in this genus.

Euxesta luteocesta, new species
(Figure 3)

This species lacks the velvety black spot between the antennae. It possesses four wing bands, none of which attains the posterior margin; a narrow yellow transverse band is present near the posterior border of the brown abdominal tergite III in the female; and narrow yellow bands are situated on the posterior borders of sternites I, II, and III of the male.

FEMALE.—Head mostly reddish pollinose except for a narrow silvery pollinose stripe on each side contiguous with eye; vertex and ocellar triangle black; face reddish pollinose except for a narrow shining brown band extending across face at level of tip of third antennal segment, this band separated from the oral margin by a reddish pollinose area narrower than the brown band. Frons at vertex 1.1 times as wide as one eye, scarcely narrowing at frontal suture; ocelli farther apart than the diameter of any one ocellus; black setae scattered irregularly over surface of frons. Antennae nearly attaining oral margin; third antennal segment reddish yellow except for a darkened anterior margin; arista dark brown.

Mesonotum blue with a slight bronze reflection, thinly dusted; pleural sclerites the same color but somewhat more shining; scutellum dark, shining bronze with a slight green reflection. Coxae, trochanters, femora, and

tibiae of all legs dark brown; knees and tarsomeres a somewhat lighter brown, the latter thickly set with short, black setae.

Wing (fig. 3) with four transverse dark bands as follows: the basal band extending from base of costal cell to a point near posterior border; the second band filling the stigma and distal eighth of costal cell, extending posterior just proximad of anterior crossvein and fading out in the third posterior cell; third band starting at costa, separated from end of stigma by a distance equivalent to width of that cell, extending posteriorly and ending on posterior crossvein about two-thirds of the distance along its length; fourth band a triangular spot with its posterior proximal corner situated just posterior to third vein. Halter yellowish white.

Abdominal tergites shining brown, tergite III with a narrow, contrasting yellow band across its entire width, situated close to the posterior border and leaving a very narrow dark brown area on the extreme posterior margin on each side of a shallow central emargination. Terminal tergite triangular, longer than width at base; abdominal sternites irregularly marked with yellow but tending to have narrowly yellow posterior margins, remaining portions of sternites the same color as tergites.

MALE.—As in the female, with the usual sexual differences. Tergites entirely dark brown, without yellow markings; posterior margins of abdominal sternites I, II and III with very narrow yellow bands.

TYPE.—Holotype, ♀, Leaf Cay, Allen's Cays, Exuma Cays, 7 January 1953, E. B. Hayden, collector. In A. M. N. H. Paratypes: 2 ♂♂, 1 ♂, same data as holotype; 1 ♀, East Bimini Island, June, 1951, P. & C. Vaurie, collectors; 1 ♂, South Bimini Island, June, 1951, M. Cazier and C. P. Vaurie, collectors; 1 ♂, South Bimini Island, July 20–31, 1951, C. & P. Vaurie, collectors; 1 ♂, South Bimini Island, Aug. 10–20, 1951, C. & P. Vaurie, collectors; 2 ♀♀, Great Bahama Island, Pine Ridge, May 13, 1953, E. B. Hayden, collector. In U. S. N. M. and A. M. N. H.

DISCUSSION.—This species runs unsatisfactorily in Curran's key (Insects of Porto Rico and the Virgin Islands, Diptera, 1928, p. 77) to *eluta* Loew, from which it may readily be separated by the yellow tergal band in the female and the somewhat different wing pattern. *E. luteocesta* runs to *quaternaria* in Curran's longer work (1935, p. 10), but the latter species is characterized by entirely yellow abdominal tergites I and II.

Euxesta notata (Wiedemann)

Ortalis notata Wiedemann, 1830, Auss. Zweifl. Ins., v. 2, p. 462.

DISTRIBUTION.—2 ♂♂, 3 ♀♀, North Bimini Island; July 1951 (P. & C. Vaurie); 1 ♀, South Bimini Island; 20–31 July 1951 (P. & C. Vaurie). Widespread throughout the New World.

Euxesta quadrivittata (Macquart)

Urophora quadrivittata Macquart, 1835, Hist. Nat. Ins., Dipt. II: 456.

Euxesta quadrivittata; Steyskal, 1952, Bernice P. Bishop Mus. Occas. Papers 20 (15): 280.

DISTRIBUTION.—Abaco Cays: 2 ♂♂, Allen's Cay, 9 May 1953; 1 ♂, 1 ♀, Great Sale Cay, 10 May 1953; 1 ♂, Green Turtle Cay, 7 May 1953; Andros Island: 1 ♂, Lisbon Creek (near South Bight), 28 April 1953; 1 ♀, Mangrove Cay, 19 June 1924 (C. E. Olson); 1 ♀, Frazier's Hog Cay, Berry Islands; 30 May 1953; Cat Island: 1 ♀, The Bight, 22 March 1953; 1 ♀, McQueen, 23 March 1953; 1 ♂, 1 ♀, Staniard Cay, Exuma Cays; 13 January 1953; 1 ♂, March Harbour (at light), Great Abaco Island; 6 May 1953; 2 ♂♂, 12 mi. N. Matthew Town, Great Inagua Island; 29 January 1953; 2 ♀♀, Deadman's Cay, Long Island; 11 March 1953; 1 ♀, North Bimini Island; July 1951 (P. & C. Vaurie); 1 ♀, near Port Nelson, Rum Cay: 16 March 1953; 1 ♂, near Cockburn Town, San Salvador Island; 18 March 1953; 1 ♀, Long Cay, so. of Grand Turk Island, 25 February 1953.

Originally described from Cuba, this species is now known to extend from Guatemala to Chile and into the West Indies. According to Steyskal it also occurs in Fiji, Guam, the Philippine Islands and Hawaii.

Euxesta quaternaria Loew

Euxesta quaternaria Loew, 1867, Berl. Ent. Ztschr. 11: 302, pl. II, fig. 11; Curran, 1935, Amer. Mus. Novit., No. 812, p. 11 (in key only).

DISTRIBUTION.—1 ♂, Nassau, New Providence Island; 16 April 1953; 2 ♂♂, 2 ♀♀, North Bimini Island; May 1951 (M. Cazier, W. Gertsch).

Previously recorded from United States (Florida), Puerto Rico and St. Thomas (Virgin Islands). The U. S. National Museum collection contains specimens from Cuba, Jamaica, Panama Canal Zone and United States (Texas).

Euxesta scoriacea Loew

Euxesta scoriacea Loew, 1876, Ztschr. Ges. Naturwiss., p. 336.

DISTRIBUTION.—Florida, Louisiana, Massachusetts, New Jersey, Texas.

Previous Bahama Islands Records.—None.

New Bahama Islands Records.—East Bimini Island: 1 ♀, June 1951 (P. & C. Vaurie).

Euxesta stigmatias Loew

Euxesta stigmatias Loew, 1867, Berl. Ent. Ztschr. 11: 310, pl. 2, fig. 18; Curran, 1935, Amer. Mus. Novit., No. 812, p. 10 (in key only).

Distribution.—4 ♂♂, 3 ♀♀, Staniard Cay, Exuma Cays; 13 January 1953; Long Island: 10 ♂♂, 6 ♀♀, Clarence Town (at light), 13 March 1953; 3 ♂♂, 7 ♀♀, Deadman's Cay, 11 March 1953; 1 ♂, near Abraham Bay, Mayaguana Island; 3 March 1953; 1 ♀, near Cockburn Town, San Salvador Island; 18 March 1953.

This widespread species occurs from northern Mexico to Brazil and throughout the West Indies east to St. Vincent.

Eumetopiella varipes (Loew)

Eumetopia varipes Loew, 1865, Dipt. Amer Sept. Ind., Cent. 6, p. 181 *in* Berl. Ent. Ztschr. 9: 55.

Eumetopiella varipes; Hendel, 1907, Wien. Ent. Ztg. 26: 98.

Distribution.—1 ♀, Allen's Cay, Abaco Cays; 9 May 1953; Andros Island: 1 ♂, 1 ♀, Fresh Creek, 23 April 1953; 1 ♂, Mangrove Cay, 26 April 1953; 1 ♀, New Portsmouth (Rock Sound), Eleuthera Island; 28 March 1953; 2 ♀♀, Alicetown, North Bimini Island; 30 December 1952; 4 ♂♂, 1 ♀, near Cockburn Town, San Salvador Island; 18 March 1953.

Originally described from Cuba, this species is represented by United States specimens in the collection of the U. S. National Museum from Texas, Mississippi and Florida.

Stenomyia tenuissima (Hendel)

Euxesta tenuissima Hendel, 1910, Dipt. Fam. Muscaridae, Sfam. Ulidiinae *in* Wytsman, Gen. Ins. Fasc. 106: 28; pl. 2, fig. 43.

Distribution.—Great Bahama Island: 1 ♀, Pine Ridge, 13 May 1953; 2 ♂♂, West End, 12 May 1953.

There are two specimens in the U. S. National Museum collection from Cuba, and several United States localities as far west as North Dakota are also represented.

Acrosticta apicalis (Williston)

Euxesta apicalis Williston, 1896, Trans. Ent. Soc. Lond., p. 375, pl. 12, fig. 128.

Acrosticta apicalis; Steyskal, 1952, Bernice P. Bishop Mus. Occas. Papers 20 (15): 279.

DISTRIBUTION.—1 ♀, Lerner Marine Lab., Bimini Island, 27 July 1947; 1 ♂, 1 ♀, Staniard Cay, Exuma Cays, 13 January 1953; 1 ♀, South Bimini Island; 2–9 August 1951 (C. & P. Vaurie).

The species occurs in North, Central, and South America, the West Indies, Hawaii, Fiji, Samoa, Marquesas and Society Islands, Guam, Saipan, and Nouru Island (west of the Gilbert Islands).

Notogramma purpurata Cole

Notogramma purpurata Cole, 1923, Proc. Calif. Acad. Sci. 12: 474.

DISTRIBUTION.—1 ♀, Staniard Cay, Exuma Cays, 13 January 1953; 1 ♀, Matthew Town, Great Inagua Island; 31 January 1953.

This species was originally described from Idaho and has been recorded from Texas and the "Gulf of California." Specimens in the U. S. National Museum are from Mexico, El Salvador, Jamaica, and Cuba.

Herina narytia (Walker)

Trypeta narytia Walker, 1849, Ins. Brit. Mus. 4: 1020.

Herina narytia; McAlpine, 1951, Can. Ent. 83 (11): 310; figs. 1a-d.

DISTRIBUTION.—1 ♂, Marsh Harbour (at light), Great Abaco Island; 6 May 1953; 7 ♂♂, 2 ♀♀, Cays 3.5 mi. SW of North Caicos Island, 28 February 1953.

Recorded by McAlpine from New Hampshire, Maryland, Georgia, and Florida. Specimens in the U. S. National Museum are from New York and New Jersey.

HENRY BIRD COLLECTION OF LEPIDOPTERA

The Department of Insects and Spiders of the American Museum of Natural History proudly announces the accession of the *Papaipema* (Lepidoptera, Noctuidae) collection of Henry Bird. It consists of 1,118 specimens of moths; of this total, 32 are holotypes, 10 are allotypes, and 63 are labelled as paratypes. The collection contains the primary types of all the species and forms described by Bird in this and related genera, as well as the holotype of *Papaipema harrisi* ab. *mulieris* Strand. It contains early stage material and examples of the larval workings of nearly every species, over 400 reared parasites, and 64 genitalic slides. In addition there are three volumes of manuscript notes, descriptions, illustrations and correspondence on the group.

Mr. Bird's interest and studies in this group began over 60 years ago. The first of a series of 34 papers was published in 1898, and the last in 1934, giving the results of his extensive life history studies, as well as the descriptions of new species. Some of his results are included in Hampson's *Catalogue of the Lepidoptera Phalaenae in the British Museum,* volume 9 (1910). In volume 7, page 286 (1926) of *The Macrolepidoptera of the World,* Draudt says that the genus *Papaipema* "comprises beautiful insects of mostly more than medium size, the American 'borers,' the life history of which has been most perfectly cleared up by the unflagging researches of Mr. Henry Bird at Rye, being unparalleled in any other genus. He quite systematically investigated the process of life of the species mostly living in the interior of large herblike plants and published quite a number of fascinatingly written essays. Our own work he has besides supported by putting at our disposal a great number of important notices and a magnificent material for the plates, for which great kindness we herewith once more express our best thanks." W. T. M. Forbes, in his *Lepidoptera of New York and Neighboring States, Part III, Noctuidae,* states (p. 191) that "almost all our life histories are due to Bird."

Hence it can be seen that this extensive collection is of great value, not only for the types and specimens it contains, but for its great contribution to our basic knowledge of this group.—Frederick H. Rindge, *The American Museum of Natural History.*

COLLECTING DIURNAL LEPIDOPTERA IN THE LESSER ANTILLES

During March and April of 1959 we visited Tobago and Barbados in the British West Indies and St. Croix and St. Thomas in the Virgin Islands, collecting for about a week on each island. The returns were good, although extremely dry conditions prevailed and the trade winds blew with more than their usual velocity. The battering from the strong winds had damaged some specimens badly.

The small island of Tobago in the southern Caribbean, lies twenty-five miles northeast of Trinidad. It is 116 square miles in area and its highest point, 1500 feet above sea level, is situated on the main ridge of the Forest Reserve near the northern end of the island. There are no roads to this high point and I was unable to reach it but did get to the town of Mariah, which is at 1000 feet. Most of my collecting in Tobago was done at the extensive Botanical Gardens situated on Patience Hill, 100 feet above sea level, in a moist area at the southern end of the island. The more humid air and a greater variety food plants helped to bring out a number of varieties of Papilionidea and a limited number of Hesperiodea. Among the specimens collected in these gardens and now in the collection of the American Museum of Natural History are: *Eurema venusta,* Boisduval, *Eurema gratiosa* Doubleday and Hewitson, *Cystineura* sp. and *Junonia* sp., *Thecla bubastus ponce* Comstock and Huntington, *Thecla spurina* Hewitson, *Leptotes cassino cassius* Cramer, *Hylaphela phleus* Drury. The catch of Hesperiidae was limited on this island and only those netted in the bright sunny fields near the town of Plymouth were in good condition. The specimens listed above are the first from this locality to be received by the Museum. In addition to these I caught about fifty assorted specimens common to this area in the families Danaiidae, Satyridae and Papilionidae.

Barbados is about 250 miles northeast of Tabago. It is 116 square miles in area with its highest point at Mt. Hillaby, 1104 feet above sea level. We traveled this small island extensively and noted a great scarcity of Hesperiidae. I sighted what I believe was *Urbanus proteus* Linnaeus or possibly *Urbanus*

dorantes Stoll, but was unable to net the specimens. Among the specimens I did net which, I am told, are the first from Barbados in the collection of the American Museum of Natural History, are the following: *Pheobis sennae* Linneaus, *Ascia monuste* Linnaeus, *Thecla* sp. (*beon-cecrops* complex), *Hemiargus hanno watsoni* Comstock and Huntington, *Hylephila phleus* Drury.

The island of St. Croix is about sixty miles southeast of Puerto Rico and is the largest of the Virgin Islands. It is 25 miles long and about seven miles wide. We ran into very poor conditions on St. Croix. It was extremely hot and dry, which it rarely is in early April. A great many Lepidoptera inhabit this island but they are most difficult to find and net. The U.S. Department of Agriculture Station is at Garden Grove. Mr. Miskimen, the Station Entomologist, showed me his extensive collections and files pertaining to local Lepidoptera. These showed that this island is the home of all the more common sub-tropical species. The best hunting is in the vicinity of Mahogany Road. Fairly high and usually damp, it starts on the western end of St. Croix not far from Frederikstad. My limited catch included about fifty specimens, mostly Pieridae and Lycaenidae of about twenty different species.

At St. Thomas the collecting was much better. Here I netted a great many Heliconiidae, among them the Zebra, *Heliconius charitonius* Linnaeus and Julia, and *Dryas julia* Fabricius. Due partly to the profusion of Hibiscus and other malvaceous shrubs and trees, there were a great many of the Zebras as well as the Danaidae, *Danaus plexipus* Linnaeus and *Danaus glippus bernice* Cramer.

Many of the small islands of the Caribbean are a Lepidopterist's paradise, but the fauna of these islands should be investigated as soon as possible, while they are in their present state. There has been a great deal of spraying of DDT and other insecticides in the Caribbean islands in recent years. The inevitable changes brought about by progress will soon be fully upon these beautiful areas, changing them to over-run tourist meccas.—RAYMOND BRUSH, *New York*.

BOOK REVIEW

INSECTS OF HAWAII. A Manual of the Insects of the Hawaiian Islands, including an Enumeration of the Species and Notes on their Origins, Distribution, Hosts, Parasites, etc. Vol. 7, Macrolepidoptera, xiv + 542 pp., 423 figs., September 30, 1958, $9.50. Vol. 8, Lepidoptera, Pyraloidea, xii + 456 pp., 347 figs., December 31, 1958, $8.00; both volumes by Elwood C. Zimmerman. University of Hawaii Press, Honolulu. (Copies of both volumes can be obtained direct from the author, MacDowell Road, Peterborough, New Hampshire as well as from the University of Hawaii Press.)

Since the Lepidoptera is one of the best known orders of insects, and the butterflies and some of the families of the macro-moths are among the most thoroughly known of all animal groups, works such as these can have great interest and value to all biologists, especially to those concerned with any phase of zoogeography or evolution. And anything dealing completely and authoritatively with any part of the biota of Hawaii is of special interest because of the isolated position of these islands. The present works are thus, indeed, highly interesting and valuable, partly because of the meticulous thoroughness with which the author has compiled and recorded all available data, and partly because of the excellence of his systematic and nomenclatorial techniques.

In the macrolepidoptera 168 "kinds" of the butterflies and macro-moths are treated; these are placed in a total of 46 genera. We write "kinds" because, as will always be the case where subjective judgment enters as to "species" vs. "subspecies," there will always be differences of opinion—one man's species are another's subspecies, and, perhaps, still another man's clines! In the macro-moths, 130 are considered to be endemic and 28 of foreign origin; while only 2 of the 10 butterflies are considered endemic! In the Pyraloidea 226 "kinds" are treated in 44 genera. These are members of the Pyraustinae, Scopariinae, Crambinae and Phycitinae, groups which many authors regard as fully worthy of family rank. Of these, 190 are considered endemic and 36 of foreign origin. The very low proportion of

endemics among the butterflies, compared with the moths, at once strikes the eye. The author's discussions of this and of other distributional factors are, of course, far too lengthy to even abstract here, but are very exhaustive and free from bias, and will prove of great interest.

The systematic treatment is admirable. Whenever possible the types were studied, in both European and New World museums. Both male and female genitalia were studied and figured for all species possible. Extensive nomenclatorial research resulted in a great many necessary name changes (in the "macros" these amount to nearly 60% of the total). However unhappy this sort of thing makes us, we admit its necessity; and it is to be trusted that at least the vast majority of changes made in these volumes will be final. The author has exercised admirable self-restraint in naming only a relatively few new species although he is aware, from what he considers inadequate material, of the existence of many others. References are given to previously published figures, and to information about the early stages. There are very extensive bibliographies, and a very valuable summary of the nomenclatorial changes. The author (who has been working on these groups for more than 25 years), the National Science Foundation and all others involved in the preparation of these volumes are to be heartily congratulated.—Alexander B. Klots, City College

AN ANNOTATED LIST OF THE LYCAENIDAE (LEPIDOPTERA, RHOPALOCERA) OF THE WESTERN HEMISPHERE

BY WILLIAM PHILLIPS COMSTOCK AND EDGAR IRVING HUNTINGTON

[CONTINUED FROM VOL. LXVII (1), P. 62]

fabricii Kirby, W. F., *Thecla*

Type Locality: United States.

Location of Type:

Original Description: 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 654 (London).

Note: The above reference attributes the name *fabricii* to Scudder (1870 (August), Proc. Boston Soc. Nat. Hist., vol. 13, pp. 272–276; Boston, Mass.). The only reference in that paper to fabricii is to "*G. Fabricii*" now considered a form of *Polygonia interrogationis* Fabricius. Hence the name *Thecla fabricii* is Kirby's.

Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 24 no. 385 (Los Angeles, Calif). (Places *fabricii* as a synonym of *edwardsii* Saunders.)

fabulla Hewitson, W. C., *Thecla*

Type Locality: Venezuela (and the Amazon).

Location of Type: British Museum (Natural History).

Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 20 (London).

Additional Reference: Hewitson W C., 1873 (February), Illus. of Diurnal Lepidoptera, vol. 1, p. 137, vol. 2, pl. 55, figs. 326, 327 ♂ (London).

facuna Hewitson, W. C., *Thecla*

Type Locality:

Location of Type: British Museum (Natural History).

Original Description: 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 202, vol. 2, pl. 80, figs. 661, 662 ♂ (London).

faga Dognin, Paul, *Thecla*

Type Locality: Loja, Ecuador.

Location of Type:

Original Description: 1895, Ann. Soc. Ent. Belgique, vol. 39, p. 105 (Bruxelles).

falacer Godart, Jean B., *Polyommatus*

Type Locality: Near Philadelphia, North America.

Location of Type:

Original Description: 1822, Encyclopédie Méthodique, vol. 9, p. 633 (Paris).

Synonyms: *lorata* Grote and Robinson, *inorata* Grote and Robinson, *heathii* Fletcher, *calanus* Auctorum, *inorata* Grote and Robinson.

Subspecies: *godarti* Field.

falerina Hewitson, W. C., *Thecla*

Type Locality: Amazon.

Location of Type: British Museum (Natural History).

Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 96, vol. 2, pl. 43, figs 168, 169 ♂ (London).

fancia Jones, E. Dukinfield, *Thecla*

Type Locality: Castro, Paraná, Brazil.

Location of Type: Jones Collection.

Original Description: 1912, Proc. Zool. Soc. London, p. 897, pl. 97, fig. 2 (London).

farmina Schaus, William, *Thecla*

Type Locality: Castro, Paraná, Brazil.

Location of Type: United States National Museum, no. 5954 ♀.

Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 421 (Washington, D. C.).

Additional References: Druce, H. H., 1907 (June), Proc. Zool. Soc. London, p. 619 (London). (Makes *farmina* a synonym of *dicaea* Hewitson).

fasciata Strecker, Herman, *Chrysophanus phlaeas* var. *americana* ab.

Type Locality: Florida.

Location of Type: Strecker Collection (1 ♀).

Original Description: 1878, Butterflies and Moths of North America. A Complete Synonymical Catalog, p. 101, no. 158 (Reading, Pa.).

fassli Druce, Hamilton H., *Thecla*

Type Locality: Monte Socorro, Colombia, 3,800 meters.

Location of Type: Druce Collection.

Original Description: 1912 (June), Ent. Mo. Mag., Series 2, vol. 23, p. 130, pl. IX, fig 10 (London).

Synonyms: *socorrensis* Draudt.

faunalia Hewitson, W. C., *Thecla*

Type Locality: Amazon.

Location of Type: British Museum (Natural History).

Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 31 (London).

Additional Reference: Hewitson, W. C., 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 161, vol. 2, pl. 63, figs. 437, 438 ♂ (London).

Synonyms: *deborrei* Capronnier.

faventia Hewitson, W. C., *Thecla*

Type Locality: Venezuela.

Location of Type: British Museum (Natural History).

Original Description: 1869 (April), Illus. of Diurnal Lepidoptera, vol. 1, p. 106, vol. 2, pl. 43, figs. 172, 173 ♂ (London). Makes *faventia* a synonym of *tephraeus* Geyer.

favonius Abbot, John and James Edward Smith, *Papilio*
Type Locality: Georgia.
Location of Type:
Original Description: 1797, Insects of Georgia, vol. 1, p. 27, pl. 14 (London).
Synonyms: *liparops* Boisduval and LeConte.

favonius Boisduval, Jean A. and John LeConte, *Thecla*
Type Locality: Central United States.
Location of Type:
Original Description: 1833, Histoire Générale et iconographie des Lépidoptères et des chenilles de l'Amérique Septentrionale, p. 95, pl. 30 (Paris).
Additional References: Boisduval, Jean A., 1852, Lépidoptères de Californié (Ann. Soc. Ent. France, vol. 10), p. 287 (Paris). (Makes *favonius* Boisduval and LeConte a synonym of *melinus* Hübner.) Kirby, W. F., 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 395 (London). (Makes *favonius* a synonym of *humili* Harris, in turn a synonym of *melinus* Hübner.)

fea Edwards, W. H., *Lycaena*
Type Locality: Waco, Texas.
Location of Type:
Original Description: 1871, Trans. Amer. Ent. Soc., vol. 3, p. 211 (Philadelphia, Pa.).
Additional Reference: Dyar, H. G., 1902, Bull. U. S. Natl. Mus., no. 52, p. 46 (Washington, D. C.). (Places *fea* as a synonym of *exilis* Boisduval.)

feildeni M'Lachlan, Robert, *Chrysophanus phloeas* var.
Type Locality: Lat. 81 deg. 45 min. North, Grant Land.
Location of Type:
Original Description: 1878 (May), Jour. Linnean Soc. (Zoology), vol. 14, p. 111 (London).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 26, no. 435 (Los Angeles, Calif.). (Places *feildeni* as a subspecies of *hypophlaeas* Boisduval.)

felderi Goodson, F. W., *Thecla*
Type Locality: Bogotá, Colombia (2 ♂♂). Ecuador (1 ♀) ex coll. Hewitson.
Location of Type: British Museum (Natural History).
Original Description: 1945 (December), Entomologist, vol. 78, p. 186 (London).

feminalis Draudt, Max, *Thecla pholeus* ♂ form
Type Locality: Surinam.
Location of Type:

Original Description: 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 785 (Stuttgart).

fenderi Macy, Ralph W., *Plebejus maricopa* f.
Type Locality: 6 miles S. E. of McMinnville, Oregon, May 25, 1929.
Location of Type: Macy Collection.
Original Description: 1931, Ent. News, vol. 42, p. 1, pl. 1 (Philadelphia, Pa.).
Additional Reference: McDonnough, J. H., 1938, Check list, pt. 1, p. 27, no. 456 (Los Angeles, Calif.). (Places *fenderi* as a subspecies of *pardalis* Behr.)

feretria Hewitson, W. C., *Thecla*
Type Locality:
Location of Type: Staudinger Collection.
Original Description: 1878 (November), Illus. of Diurnal Lepidoptera, vol. 1, p. 210, vol. 2, pl. 84, figs. 709, 710 (London).

fernanda Jones, E. Dukinfield, *Thecla*
Type Locality: Fernandes Pinheiro, Paraná, Brazil.
Location of Type: Jones Collection.
Original Description: 1912, Proc. Zool. Soc., London, p. 899, pl. 97, fig. 7 (London).

ferniensis Chermock, F. H., *Plebeius*
Type Locality: Fernie, British Colombia, July 16.
Location of Type: Author's collection.
Original Description: 1944 (November), Can. Ent., vol. 76, p. 215 (Guelph, Ontario).

fessa Möschler, H. B., *Thecla*
Type Locality: Interior of Surinam.
Location of Type:
Original Description: 1883, Verh. zool.-bot. Ges., vol. 32, p. 310, pl. 17, fig. 4 (Wien).

festata Weeks, A. G. Jr., *Hypolycaena*
Type Locality: San José del Cabo, Lower California.
Location of Type: Museum of Comparative Zoology.
Original Description: 1891 (June), Ent. News, vol. 2, no. 6, p. 102 Philadelphia, Pa.).
Additional Reference: Weeks, A. G. Jr., 1905, Illus. of Diurnal Lepidoptera, p. 1, pl. 1, figs. 1 ♂, 2 ♀ (Boston, Mass.).

fidelia Hewitson, W. C., *Thecla*
Type Locality: Venezuela.
Location of Type: British Museum (Natural History).
Original Description: 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 167, vol. 2, pl. 66, figs. 468, 469 ♂ (London).

fidena Hewitson, W. C., *Thecla*
Type Locality:
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 112, vol. 2, pl. 44, figs. 183, 184 ♂ (London).
Additional Reference: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 61 (New York, N. Y.). (Give the localities as Hispaniola and Puerto Rico.)

fidentia Hewitson, W. C., *Thecla*
Type Locality: Venezuela.
Location of Type: British Museum (Natural History).
Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 32 (London).
Additional Reference: Hewitson, W. C., 1873 (February), Illus. of Diurnal Lepidoptera, vol. 1, p. 141 (London). (Makes *fidentia* a synonym of *phrutus* Geyer)

filenus Poey, Felipe, *Polyommatus*
Type Locality: Cuba.
Location of Type:
Original Description: 1832, Centurie de Lépidoptères de l'ile de Cuba, no. 13, 3 figs. (Paris).
Additional Reference: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 108 (New York. N. Y.). (Make *filenus* a subspecies of *hanno* Stoll.)
Synonyms: *astenidas* Lucas, *astenidia* Draudt, *philenus* Poey.

fletcheri Michener, Charles D. and Cyril F. dos Passos, *Strymon strigosus*
Type Locality: Manitoba.
Location of Type: United States National Museum (lectotype).
Original Description: 1942 (November), Amer. Mus. Novitates, no. 1210, p. 3 (New York, N. Y.).
Note: New name for *Thecla strigosa* var. *liparops* Fletcher (1903, Trans. Royal Soc. Canada, no. 2, vol. 9, sec. 4, p. 211).

floralia Druce, Hamilton H., *Thecla*
Type Locality: Maranham, North Brazil.
Location of Type: Godman Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 572, pl. 31, fig. 6 ♂ (London).
Additional Reference: Draudt, Max, 1919 (November), The Macrolepidoptera of the World, vol. 5, p. 747, pl. 147-b (Stuttgart). (Makes *floralia* a subspecies of *tagyra* Hewitson.)

florencia Clémence, Victor L., *Lycaena*
Type Locality: Huachuca Mountains, Arizona, May and June.
Location of Type: Clémence Collection.
Original Description: 1914 (January), Ent. News, vol. 25, p. 28 (Philadelphia, Pa.).

Additional Reference: McDonnough, J. H., 1938, Check list, pt. 1, p. 27, no. 444 (Los Angeles, Calif.). (Places *florencia* as a synonym of *gyas* Edwards.)

florenciae Nabokov, V., *Lycaena* (not Clémence) See *florencia* Clémence
Type Locality:
Location of Type:
Original Description: 1945, Psyche, vol. 52, p. 20 (Cambridge, Mass.).

floreus Druce, Hamilton H., *Thecla*
Type Locality: Tapajos, Amazonas, Brazil.
Location of Type: Godman Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 581, pl. 33, fig. 8 ♂ (London).

floridensis Morrison, Herbert K., *Lycaena cassius* var.
Type Locality: Key West, Florida, February 1–10.
Location of Type: Edward Burgess and H. K. Morrison Collections.
Original Description: 1873 (November), Bull. Buffalo Soc. Nat. Sci., vol. 1, p. 187 (Buffalo, N. Y.).
Additional Reference: Clench, Harry K. 1942, Jour. New York Ent. Soc., vol. 50, p. 243 (Lancaster, Pa.). (Makes *floridensis* a synonym of *theonus* Lucas.)

florus Edwards, William H., *Chrysophanus*
Type Locality: Red Deer River, British America.
Location of Type:
Original Description: 1883 (November), Can. Ent., vol. 15, p. 210 (London, Ontario).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 26, no. 432 (Los Angeles, Calif.). (Places *florus* as a subspecies of *helloides* Boisduval.)
Synonyms: *hulbirti* Field, *sternitzkyi* Field.

flosculus Druce, Hamilton H., *Thecla*
Type Locality: Espiritu Santo, Brazil.
Location of Type: Druce Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 583, pl. 33, fig. 15 ♂ (London).

fortuna Druce, Hamilton H., *Thecla*
Type Locality: Yurimaguas, Peru and Tapajos, Amazonas, Brazil.
Location of Type: Godman Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London p. 608 (London).
Additional Reference: Draudt, Max, 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 794 (Stuttgart). (Considers *fortuna* a subspecies of *vitruvia* Hewitson.)

fostera Schaus, William, *Thecla*
Type Locality: Sao Paulo, Southeast Brazil.

Location of Type: United States National Museum, no. 5953 ♀.
Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 421 (Washington, D. C.).

fotis Strecker, Herman, *Thecla*
Type Locality: Arizona.
Location of Type: Strecker Collection (1 ♂, 1 ♀).
Original Description: 1877 (November), Lepidoptera, Rhopaloceres and Heteroceres, p. 129 (Reading, Pa.).
Additional Reference: Holland, W. J., 1931, The Butterfly Book, revised edit., p. 227, pl. 64, fig. 11 ♂ (Garden City, N. Y.).

foyi Schaus, William, *Thecla*
Type Locality: Peru.
Location of Type: United States National Musuem, no. 5944.
Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 417 (Washington, D. C.).

francis Weeks, A. G. Jr., *Thecla*
Type Locality: Alezuni, Bolivia, August 8, 1899.
Location of Type: Museum of Comparative Zoology.
Original Description: 1901 (November), Can. Ent., vol. 23, p. 322 (London, Ontario).
Additional Reference: Weeks, A. G. Jr., 1905, Illus. of Diurnal Lepidoptera, p. 99, pl. 43, fig. 3 (Boston, Mass.).

franki Field, William D., *Strymon melinus*
Type Locality: Lawrence, Kansas, August 9, 1934.
Location of Type: W. D. Field Collection, United States National Museum.
Original Description: 1938 (October), Jour. Kansas Ent. Soc., vol. 11, no. 4, p. 127 (McPherson, Kansas).

franklinii Curtis, John, *Polyommatus*
Type Locality: Arctic America, end of July.
Location of Type:
Original Description: 1835, Appendix, Narrative Second Voyage in Search North-west Passage by Sir John Ross, Insects by John Curtis, p. lxix, pl. A, figs. 8, 9 (London).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 27, no. 452 (Los Angeles, Calif.). (Places *franklinii* as a synonym of *aquilo* Boisduval.)

fretchini Chermock, F. H., *Plebeius scudderi*
Type Locality: Paradise Valley, Mt. Ranier, Washington.
Location of Type: Author's Collection.
Original Description: 1944 (November), Can. Ent., vol. 76, p. 214 (Guelph, Ontario).

fridayi Chermock, F. H., *Plebeius melissa*
Type Locality: Mammouth, California, July 27, 1927.

Location of Type: Author's Collection.
Original Description: 1944 (November), Can. Ent., vol. 76, p. 215 (Guelph, Ontario).

fuliginosa Edwards, William H., *Lycaena*
Type Locality: California.
Location of Type:
Original Description: 1861, Proc. Acad. Nat. Sci. Phila., p. 164 (Philadelphia, Pa.).
Synonyms: *immaculata* Gunder, *suasa* Boisduval.
Subspecies: *semiluna* Klots.

fulla Edwards, William H., *Lycaena*
Type Locality: California (♂, ♀).
Location of Type:
Original Description: 1870 (November), Trans. Amer. Ent. Soc., vol. 3, p. 194 (Philadelphia, Pa.).
Additional Reference: McDonnough, J. H., 1938, Check list, pt. 1, p. 27, no. 455 (Los Angeles, Calif.). (Places *fulla* as a synonym of *icarioides* Boisduval.)

fulliolus Hulst, George D., *Chrysophanus americanus* var.
Type Locality: None given.
Location of Type:
Original Description: 1886 (December), Ent. Amer., vol. 2, p. 182 (Brooklyn, N. Y.).
Additional Reference: McDonnough, J. H., 1938, Check list, pt. 1, p. 26, no. 435 (Los Angeles, Calif.). (Places *fulliolus* as an aberration of *hypophlaeas* Boisduval.)

fulvescens Edwards, Henry, *Thecla saepium* var.
Type Locality: Lake Tahoe; Tehachepi Pass; Havilah, Kern County, California.
Location of Type: American Museum of Natural History. (1 ♀ from Tehachepi, California, July; 1 ♀ from Havilah, California).
Original Description: 1877, [1876], Proc. Calif. Acad. Sci., vol. 7, p. 172 (San Francisco, Calif.).

fulvus Rummel, Charles, *Heodes hypophlaeas* ab.
Type Locality: Green Village, New Jersey.
Location of Type: Rummel Collection.
Original Description: 1928, Bull. Brooklyn Ent. Soc., vol. 23, p. 268.
Synonyms: *bulbus* (Zool. Record).

fumida Scudder, Samuel H., *Cyaniris pseudargiolus* ab.
Type Locality:
Location of Type:
Original Description: 1889, The Butterflies of the eastern United States and Canada with special reference to New England, vol. 2, p. 933 (Cambridge, Mass.).

furcifur Druce, Hamilton H., *Thecla*
Type Locality: Espiritu Santo, Brazil.
Location of Type: Druce Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 621 (London).

furina Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Quiche Mountains, Guatemala.
Location of Type: British Museum (Natural History).
Original Description: 1887 (May), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 28, vol. 3, pl. 51, figs. 13, 14 ♂ (London).
Additional Reference: Draudt, Max, 1919 (December), The Macrolepidoptera of the World, vol. 5, p. 753, pl. 148-h (Stuttgart). (Considers *furina* to be a subspecies of *aegides* Felder and Felder.)

fusius Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Chisoy Valley, Guatemala.
Location of Type: British Museum (Natural History).
Original Description: 1887 (May), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 34, vol. 3, pl. 52, figs. 6, 7 ♂ (London).

gabatha Hewitson, W. C., *Thecla*
Type Locality: Curaray, Ecuador.
Location of Type: British Museum (Natural History).
Original Description: 1870 (March), Equatorial Lepidoptera, Buckley, p. 62 (London).
Additional Reference: Hewitson, W. C., 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 174, vol. 2, pl. 68, figs. 504, 505 ♀ (London).
Synonyms: *balius* Godman and Salvin.

gabelus Godart, Jean B., *Polyommatus*
Type Locality: Brazil.
Location of Type:
Original Description: 1822, Encyclopédie Méthodique, vol. 9, p. 639 (Paris).
Additional Reference: Druce, H. H., 1907, Proc. Zool. Soc. London, p. 568 (London). (Did not recognize the species.)

gabina Godman, F. D. and O. Salvin, *Thecla*
Type Locality: David, Panamá.
Location of Type: British Museum (Natural History).
Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhoalocera, vol. 2, p. 82, vol. 3, pl. 57, figs. 20, 21 ♂ (London).
Note: This name might become a homonym of *Polyommatus gabinus* Godart.

gabinus Godart, Jean B., *Polyommatus*
Type Locality: Brazil?
Location of Type:

Original Description: 1822, Encyclopédie Méthodique, vol. 9, p. 659 (Paris).

gabriel Godart, Jean B., *Polyommatus*
Type Locality: "de l'Amérique meridionale".
Location of Type:
Original Description: 1822, Encyclopédie Méthodique, vol. 9, p. 622, no. 18 (Paris).
Additional Reference: Kirby, W. F., 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 379 (London). (Makes *gabriel* a synonym of *gabriela* Cramer.)

gabriela Cramer, Pierre, *Papilio*
Type Locality: "Berbice". Hewitson gives Amazon.
Location of Type:
Original Description: 1775, Papillons exotiques des trois parties du monde, vol. 1, p. 9, pl. 6, figs. E, F (Amsterdam).
Additional Reference: Druce, H. H., 1907 (June), Proc. Zool. Soc. London, p. 571 (London). (Defines *gabriela.*)
Synonyms: *gabriel* Godart, *gabrielis* Fabricius.

gabrielis Fabricius, Johann Christian, *Papilio Plebeius Ruralis*
Type Locality:
Location of Type:
Original Description: 1787, Mantissa Insect., vol. 2, p. 65, no. 617 (Hafniae).
Additional References: Donovan, Edward, 1824, Naturalist's Repository, vol. 2, pl. 44, figs. 2 and text (London). Godart, J. B., 1822, Encyclopédie Méthodique, vol. 9, p. 622 (Paris). (Makes *gabrielis* a synonym of his new name *gabriel.* Both names are synonymous with *gabriela* Cramer.)

gadira Hewitson, W. C., *Thecla*
Type Locality: Guatemala (Polochic Valley).
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 113, vol. 2, pl 44, figs. 181, 182 ♀ (London).
Additional Reference: Godman, F. D. and O. Salvin, 1887 (August), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 59, vol. 3, pl. 55, figs. 13, 14 ♂ (London).

gaina Hewitson, W. C., *Thecla*
Type Locality: Curaray, Ecuador.
Location of Type: British Museum (Natural History).
Original Description: 1870 (March), Equatorial Lepidoptera, Buckley, p. 61, (London).
Additional Reference: Hewitson, W. C., 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 176, vol. 2, pl. 69, figs. 513, 514 ♂ (London).

galliena Hewitson, W. C., *Thecla*
Type Locality: Chontales (Nicaragua), Espiritu Santo (Brazil).
Location of Type: British Museum (Natural History).
Original Description: 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 185, vol. 2, pl. 74, figs. 575, 576 ♂ (London).

gamma Druce, Hamilton H., *Thecla*
Type Locality: Tucumán, Argentina.
Location of Type: Museum Druce.
Original Description: 1909 (September), Trans. Ent. Soc. London, p. 437, pl. 11, fig. 9 ♀ (London).

ganymedes Cramer, Pierre, *Papilio*
Type Locality: "Indes Occidentales".
Location of Type:
Original Description: 1775, Papillons exotiques des trois parties du monde, vol. 1, p. 64, pl. 40, figs. C, D (Amsterdam).
Synonyms: *nobilis* Herrich-Schäffer, *bimaculata* Möschler syn.

gargara Hewitson, W. C., *Thecla*
Type Locality: Amazon (Pará).
Location of Type: British Museum (Natural History).
Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 8 (London).
Additional Reference: Hewitson, W. C., 1869 (April), Illus. of Diurnal Lepidoptera, vol. 1, p. 135, vol. 2, pl. 53, figs. 306, 307 ♀ (London).

gargophia Hewitson, W. C., *Thecla*
Type Locality: Brazil (Espiritu Santo).
Location of Type: British Museum (Natural History).
Original Description: 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 190, vol. 2, pl. 75, figs. 597, 598 ♂ (London).

garthi Gunder, Jean D., *Plebeius saepiolus hilda* tr. f.
Type Locality: Tahquitz Valley, Riverside County, California, June 27, 1927.
Location of Type: American Museum of Natural History.
Original Description: 1928 (July), Can. Ent., vol. 60, p. 168, pl. B, fig. 21 (Orillia, Ontario).
Additional Reference: McDonnough, J. H., 1938, Check list, pt. 1, p. 27, no. 453 (Los Angeles, Calif.). (Places *garthi* as an aberration of *saepiolus hilda* Grinnell.)

gaumeri Godman, F. D., *Thecla*
Type Locality: Mexico, Valladolid and Temax, Yucatan.
Location of Type: British Museum (Natural History).
Original Description: 1901 (October), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 714, vol. 3, pl. 111, figs. 1, 2 ♂ (London).

gauna Boisduval, Jean A., *Thecla*
Type Locality: Costa Rica.
Location of Type:
Original Description: 1870, Considérations sur des Lépidoptères Envoyés du Guatemala à M. de l'Orza, p. 16 (Rennes).

geba Hewitson, W. C., *Thecla*
Type Locality:
Location of Type: British Museum (Natural History).
Original Description: 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 198, vol. 2, pl. 79, figs. 641, 642 ♂ (London).

gedeon Capronnier, J. B., *Thecla* Nomen nudum
Type Locality: Botafogo, Brazil.
Location of Type:
Original Description: 1874, Ann. Soc. Ent. Belgique, Vol. 17, p. 15 (Bruxelles).

gedrosia Hewitson, W. C., *Thecla*
Type Locality: Amazon (Tapajos).
Location of Type: British Museum (Natural History).
Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 10 (London).
Additional Reference: Hewitson, W. C., 1869 (April), Illus. of Diurnal Lepidoptera, vol. 1, p. 126, vol. 2, pl. 51, figs. 270, 271 ♂ (London).

geminata Draudt, Max, *Thecla*
Type Locality: Río Songo, Bolivia.
Location of Type:
Original Description: 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 796, pl. 158-b (Stuttgart).

gemma Druce, Hamiltin H., *Thecla*
Type Locality: Río Napo, Peru.
Location of Type: Godman Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 581, pl. 33, fig. 9 ♂ (London).

genena Hewitson, W. C., *Thecla*
Type Locality: Amazon (Pará).
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 111, vol. 2, pl. 44, figs. 185, 186 ♂ (London).

genius Geyer, Carl, *Lamprospilus*
Type Locality: "West Indies".
Location of Type:
Original Description: 1832, Zuträge zur Sammlung exotischer Schmettlinge, vol. 4, p. 30, figs. 727, 728 ♀ (Augsburg).

gentiana Druce, Hamilton H., *Thecla*
Type Locality: Bogotá, Colombia.

Location of Type: Druce Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 601, pl. 36, fig. 1 ♂ (London).

gentilla Schaus, William, *Thecla*
Type Locality: Petropolis, Brazil.
Location of Type: United States National Museum, no. 5951 ♂.
Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 420 (Washington, D. C.).
Additional Reference: Schaus, William, 1920, Ent. News, vol. 31, p. 176 (Philadelphia, Pa.). (Makes *gentilla* a synonym of *atrox* Butler.)

gertschi dos Passos, Cyril F., *Plebeius saepiolus*
Type Locality: Cedar Breaks, near Cedar City, Utah, July 6, 1931.
Location of Type: American Museum of Natural History.
Original Description: 1938 (March), Can. Ent., vol. 70, no. 3, p. 46, pl. 2, figs. 5, 6, 7, 8 (Orillia, Ontario).

getus Fabricius, Johann Christian, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1787, Mantissa Insect., vol. 2, p. 66 (Hafniae).
Additional References: Kirby, W. F., 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 386 (London). (Makes *getus* a synonym of *caranus* Cramer.) Goodson, F. W., 1945 (December), Entomologist, vol. 78, p. 186 (London). (Considers *getus* a distinct species from *caranus* Cramer.)
Note: *getus* is a substitute name for *pelops* Cramer (1781) by original reference, but *pelops* Cramer (1781) (Lycaenidae) is a homonym of *Papilio pelops* Cramer (1777) (Riodinidae).
Synonyms: *petus* Fabricius.

giapor Schaus, William, *Thecla*
Type Locality: Sao Paulo, S. E. Brazil.
Location of Type: United States National Museum, no. 5921.
Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 407 (Washington, D. C.).
Additionl Reference: Draudt, Max, 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 787, pl. 145-1 (Stuttgart).

gibberosa Hewitson, W. C., *Thecla*
Type Locality: New Grenada.
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 85, vol. 2, pl. 33, figs. 48, 49 ♂ (London).

gibboni Gunder, Jean D., *Lycaena dione* tr. f.
Type Locality: Maniota, Manitoba.
Location of Type: Canadian National Collection, Ottawa.
Original Description: 1927 (December), Can. Ent., vol. 59, p. 284, pl. A, fig. 13 (Orillia, Ontario).

gigantea Hewitson, W. C., *Thecla*
Type Locality: Pará, Brazil.
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 83, vol. 2, pl. 32, figs. 43, 44 ♂ (London).

giganteus Röber, J., *Eumaeus*
Type Locality: Macas, Ecuador.
Location of Type: Niepelt Collection.
Original Description: 1927, Intern. Ent. Zeit., vol. 21, p. 105, pl. opp. p. 182, fig. 5 ♀ type (Guben).

gillottae Riley, N. D., *Erora*
Type Locality: Exposed summit above Río Reventado, on Mt. Irazu, 2 miles North of Cartago, Costa Rica, 5100 ft., December, 1922.
Location of Type: British Museum (Natural History).
Original Description: 1924, Entomologist, vol. 57, p. 88 (London).

gispa Hewitson, W. C., *Thecla*
Type Locality: Amazon.
Location of Type: British Museum (Natural History).
Original Description: 1865, Illus. of Diurnal Lepidoptera, vol. 1, p. 75, vol. 2, pl. 30, fig. 25 ♂ (London).

gizela Hewitson, W. C., *Thecla*
Type Locality: Bolivia.
Location of Type: British Museum (Natural History).
Original Description: 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 197, vol. 2, pl. 78, figs. 631 632 ♂ (London).

glaucon Edwards, William H., *Lycaena*
Type Locality: Nevada (♂, ♀) collected by Henry Edwards).
Location of Type:
Original Description: 1871 (January), Trans. Amer. Ent. Soc., vol. 3, p. 210 (Philadelphia, Pa.).
Additional References: Barnes, W. J. and J. H. McDonnough, 1916, Contributions to the natural history of the Lepidoptera of North America, vol. 3, no. 2, p. 117 (Decatur, Ill.). (Suggest that a *glaucon* female from Nevada in the American Museum of Natural History collection is probably one of the original types.) Mattoni, Rudolph, H. T., 1954 (June), The Lepidopterists' News, vol. 8, nos. 1–2, p. 8 (New Haven, Conn.). (Makes *glaucon* a synonym of *battoides* Behr.)
Subspecies: *centralis* Barnes and McDonnough, *intermedia* Barnes and McDonnough, *malcolmi* Gunder syn.

gloriosa Lathy, Percy I., *Thecla*
Type Locality: Colombia. Chocó, Rio Micai-Joly. 23:V-18.VI, 1924. 1 ♂, Collector Werner Hopp.
Location of Type: Fournier Collection, Paris.
Original Description: 1930 (June), Trans. Ent. Soc. London, p. 134, pl. 9, fig. 5 (London).

gnosia Hewitson, W. C,. *Thecla*
Type Locality: ?
Location of Type: British Museum (Natural History).
Original Description: 1868, Specimen of a Catalogue of Diurnal Lepidoptera in the British Museum, p. 9 (London).
Additional Reference: Hewitson, W. C., 1873 (February), Illus. of Diurnal Lepidoptera, vol. 1, p. 150, vol. 2, pl. 59, figs. 386, 387 ♀ (London).

godarti Field, William D., *Strymon falacer*
Type Locality: Rosement, Teller County, Colorado, June 30, 1936.
Location of Type: W. D. Field Collection, United States National Museum?
Original Description: 1938 (October), Jour. Kansas Ent. Soc., vol. 11, no. 4, p. 129 (McPherson, Kansas).

godartii Boisduval, Jean A., *Eumenia*
Type Locality: Central America.
Location of Type:
Original Description: 1870, Considérations sur des Lépidoptères Envoyés due Gutemala à M. de l'Orza, p. 13 (Rennes).
Synonyms: *costaricensis Draudt.*

godmani Goodson, F. W., *Thecla*
Type Locality: Chisoy Valley, Guatemala (1 ♂).
Location of Type: British Museum (Natural History).
Original Description: 1945 (November), Entomologist, vol. 78, p. 169 (London).
Note: Goodson remarks that: "This species is figured by Godman and Salvin in Biol. Cent. Amer. on pl. 48, figs. 20, 21, as the ♂ of *nobilis* H.-Schäffer, but *nobilis* H.-Schäffer is the ♀ of *ganimedes* as is fig. 22, G. and S."

goleta Hewitson, W. C., *Thecla*
Type Locality: New Granada.
Location of Type: British Museum (Natural History).
Original Description: 1877 (January, Illus. of Diurnal Lepidoptera, vol. 1, p. 203, vol. 2, pl. 81, figs. 666, 667 ♂ (London).

goodsoni Clench, Harry K., *Thecla*
Type Locality: Tegucigalpa, Honduras.
Location of Type: British Museum (Natural History).
Original Description: 1946 (August), Entomologist, vol. 79, p. 186 (London).

gorgon Boisduval, Jean. A., *Polyommatus*
Type Locality: Mountains of California.
Location of Type: United States National Museum?
Original Description: 1852, Ann. Soc. Ent. France, Series 2, vol. 10, p. 292 (Paris).
Additional Reference: Oberthür, Charles, 1913 (October), Etudes de Lepidopterologie Comparee, fasc. 9, pt. 1, p. 40, pl. 236, figs. 1929 ♂, 1930 ♀ (Rennes).

gorgonioi Gunder, J. D., *Phaedrotes piasus catalina* ab. ♂
Type Locality: San Gorgonio Mts., San Bernardino County, California, June 13, 1921.
Location of Type: American Museum of Natural History.
Original Description: 1925 (January), Ent. News, vol. 36, p. 4, pl. 1, fig. P (Philadelphia, Pa.).

gossei Comstock, W. P. and E. I. Huntington, *Thecla acis*
Type Locality: Don Christopher's Cove, St. Ann, Jamaica, B. W. I., March.
Location of Type: American Museum of Natural History.
Original Description: 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 67, pl. 1, fig. 3 ♀ (New York, N. Y.).

gottschalki Clark, Austin H. and Lelia F. Clark, *Strymon cecrops* ab.
Type Locality: Fort Lewis Mountain, Roanoke County, Virginia, August 11, 1937, ♀.
Location of Type: United States National Museum, no. 52256.
Original Description: 1938, Proc. Biol. Soc. Wash., vol. 51, p. 3 (Washington, D. C.).

gozora Boisduval, Jean. A., *Lycaena*
Type Locality: Honduras.
Location of Type:
Original Description: 1870, Considérations sud des Lépidoptères Envoyés du Guatemala à M. de l'Orza, p. 17 (Rennes).
Additional References: Draudt, Max, 1921, The Macrolepidoptera of the World, vol. 5, p. 818 (Stuttgart). (Considers *gozora* the southernmost form of *pseudargiolus* Boisduval and LeConte.) McDunnough, J. H., 1938, Check list, pt. 1, p. 29, no. 475 (Los Angeles, Calif.). (Places *gozora* as a subspecies of *pseudargiolus* Boisduval and LeConte.)

grata Köhler, P., *Itylos*
Type Locality: "Primer Pino," Departamento Las Lajas, Argentina, 1600 m., December, 1932.
Location of Type: Alberto Breyer Collection.
Original Description: 1934 (May), Rev. Soc. Ent. Argentina, vol. 6, p. 39, figs. 1, 2.

gravenotata Klots, Alexander B., *Lycaena heteronea*
Type Locality: Plainview, Jefferson County, Colorado, Alt. 6783 ft.
Location of Type: American Museum of Natural History.
Original Description: 1930 (June), Bull. Brooklyn Ent. Soc., vol. 25, p. 163, figs. 1–4 (Brooklyn, N. Y.).

grayi Comstock, W. P. and E. I. Huntington, *Eumaeus atala*
Type Locality: Miami, Florida.
Location of Type: American Museum of Natural History.
Original Description: 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 60 (New York, N. Y.).

greppa Dyar, Harrison G., *Thecla*
Type Locality: Misantla, June, 1911; Santa Rosa, V. C., May and August, 1906, Mexico.
Location of Type: United States National Museum, no. 14,279 (3 ♂ ♂).
Original Description: 1912, Proc. U. S. Natl. Mus., vol. 42, p. 42 (Washington, D. C.).
Additional References: Schaus, William, 1920, Ent. News, vol. 31, p. 176 (Philadelphia, Pa.). (Makes *greppa* Dyar a synonym of *philinna* Hewitson.) Draudt, Max, 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 787 (Stuttgart). (Makes *greppa* a subspecies of *philinna* Hewitson.
Note: *greppa* appears to us to be a good species.

griqua Schaus, William, *Lycaena*
Type Locality: Castro, Parana, Brazil.
Location of Type: United States National Museum, no. 5919.
Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, 6. 407 (Washington, D. C.).

grisea Dufrane, Abel, *Thecla melimus.*
Type Locality: Trujillo, Peru.
Location of Type:
Original Description: 1939 (August), Bull. & Ann. Soc. Ent. Belgique, vol. 79, p. 290.
Synonyms: *nigriplaga* Dufrane.

grunus Boisduval, Jean. A., *Thecla*
Type Locality: California.
Location of Type: United States National Museum?
Original Description: 1852, Ann. Soc. Ent. France, Series 2, vol. 10, p. 289 (Paris).
Additional Reference: Oberthür, Charles, 1913 (October), Etudes de Lepidoterologie Comparee, fasc. 9, pt. 1, p. 40, pl. 235, fig. 1923 (Rennes).
Subspecies: *herri* Field, *lorquini* Field, *chloris* Field syn.

gryneus Hübner, Jacob, *Lycus*
Type Locality:
Location of Type:
Original Description: 1819, Verzeichniss bekannter Schmettlinge, p. 74, no. 732 (Augsburg).
Note: This is a new name for *damon* Cramer and a synonym by reference.

guacanagari Wallengrén, H. D. J., *Thecla*
Type Locality: Puna Island, Ecuador, March.
Location of Type: Stockholm Museum.
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Location of Type: United States National Museum, no. 5947.
Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 418 (Washington, D. C.).

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Type Locality: Bouquet Canyon, Los Angeles County, California, July 16, 1932.
Location of Type: Academy of Sciences, San Francisco, California. (One pair paratypes in American Museum of Natural History).
Original Description: 1933, Ent. News, vol. 44, p. 97 (Philadelphia, Pa.).

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Type Locality: Oriente (Sierra Maestra, 1000 ft.), Cuba.
Location of Type: Museum of Comparative Zoology. Cambridge, Massachusetts.
Original Description: 1935 (February), Bull. Mus. Comp. Zool., vol. 78, no. 2, pp. 195–196 (Cambridge, Mass.).
Additional Reference: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci. vol. 45, p. 89 (New York, N. Y.). (Make *gundlachianus* a subspecies of *bazochii* Godart.)

guzanta Schaus, William, *Thecla*
Type Locality: Jalapa, Orizaba, Mexico.
Location of Type: United States National Museum, no. 5952.
Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 420 (Washington, D. C.).

gyas Edwards, William H., *Lycaena*
Type Locality: Arizona.
Location of Type: United States National Museum?
Original Description: 1871 (January), Trans. Amer. Ent. Soc., vol. 3, p. 210 (Philadelphia, Pa.).
Additional Reference: Nabokov, V., 1945, Psyche, vol. 52, p. 51, pl. 4 (Cambridge, Mass.). (Places it as a subspecies as *Hemiargus ceraunus*
Synonyms: *astragala* Wright, *florencia* Clemence.
gyas Edwards.)

[To be continued]

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OBSERVATIONS ON THE NESTING BEHAVIOR OF THREE SPECIES OF THE GENUS CRABRO (HYMENOPTERA, SPHECIDAE)

By Howard E. Evans
Cornell University, Ithaca, N. Y.

Crabro is a genus of predominantly Holarctic distribution containing approximately 70 species, about half that number Nearctic. In much of the older literature, the generic name *Thyreopus* is used for these wasps. The nesting behavior of only one Nearctic species, *cingulatus* (Packard), has been described, but several of the European species have been studied. Although I have rarely found wasps of this genus nesting, in the summer of 1958 I had the unusual experience of finding three different species nesting, each in a different area. Although none of my observations are especially detailed, they do afford a better insight into the ethology of the genus as well as into the types of specific differences to be expected.

I am indebted to Karl V. Krombein for his assistance in identifying the three species of *Crabro,* to W. L. Downes for determining the dipterous parasites, and to J. G. Chillcott, R. H. Foote, F. C. Harmston, L. L. Pechuman, C. W. Sabrosky, and W. W. Wirth for determining the dipterous prey. Numbers in the text refer to field notes which, together with specimens of wasps and prey, have been placed on permanent file at Cornell University. Larvae of all three species were collected, and these have been described elsewhere (Evans, 1959).

Crabro advenus Smith

During early July, 1958, several wasps of this species nested

around my home two miles south of Ithaca, N.Y. Most of the observations were made on one individual (No. 1546) which was nesting in a bare place among tomato plants in my garden. The soil here is a rather hard clay-loam containing many stones. This individual was first seen on the evening of July first, a very hot day. She brought prey into her nest from 8:10 until 8:30 P.M., by which time the sun had set and it was getting rather dark. The nest entrance was a simple vertical hole in the ground, with no surrounding rim of soil. On the following day she was again observed bringing in prey 7:00–8:30 P.M.; on this date there was a small rim of fresh soil around the entrance, indicating fresh digging inside the nest. On July 3 there appeared to be further activity in the afternoon and evening, but the wasp was not actually seen. July 4 was a rainy day, and the nest was closed from inside all day. July 5 was also rainy, but during a period of partial clearing in the afternoon the wasp was very active, bringing prey at 3:55, 4:00, 4:08, 4:10, 4:12 P.M., and doubtless at other times before and after this. Each time she remained within the nest from 30 seconds to two minutes. On July 6 at 9:00 A.M. she was seen making a final closure of the nest. Earth was loosened with the mandibles from the nest opening, both inside and out, and scraped into the burrow. At intervals the wasp backed into the burrow and packed the soil with the tip of her abdomen. When the filling was nearly complete, the wasp was captured and the nest dug out.

When bringing prey, the wasp entered the nesting area about 20–30 cm. high, flying very swiftly, then plunged headlong into the burrow. Only by covering the nest entrance artificially was I able to observe that the fly is held venter-up against the abdomen of the wasp, grasped by the wasp's middle legs. It appeared to be held somewhat more loosely than in the bembicine wasps, and it is probable that it is held by only one of the middle legs. The burrow entrance is always left open during provisioning, but it is closed with a plug of earth during the night and periods of inclement weather. My impression is that the wasp makes this plug from the inside and spends these periods inside the nest, but I have no actual data on this point.

The nest of this individual was found to contain eight cells which varied in depth from 6 to 12 cm. (Fig. 1, No. 1546). These cells appeared to be arranged along two major branches of the

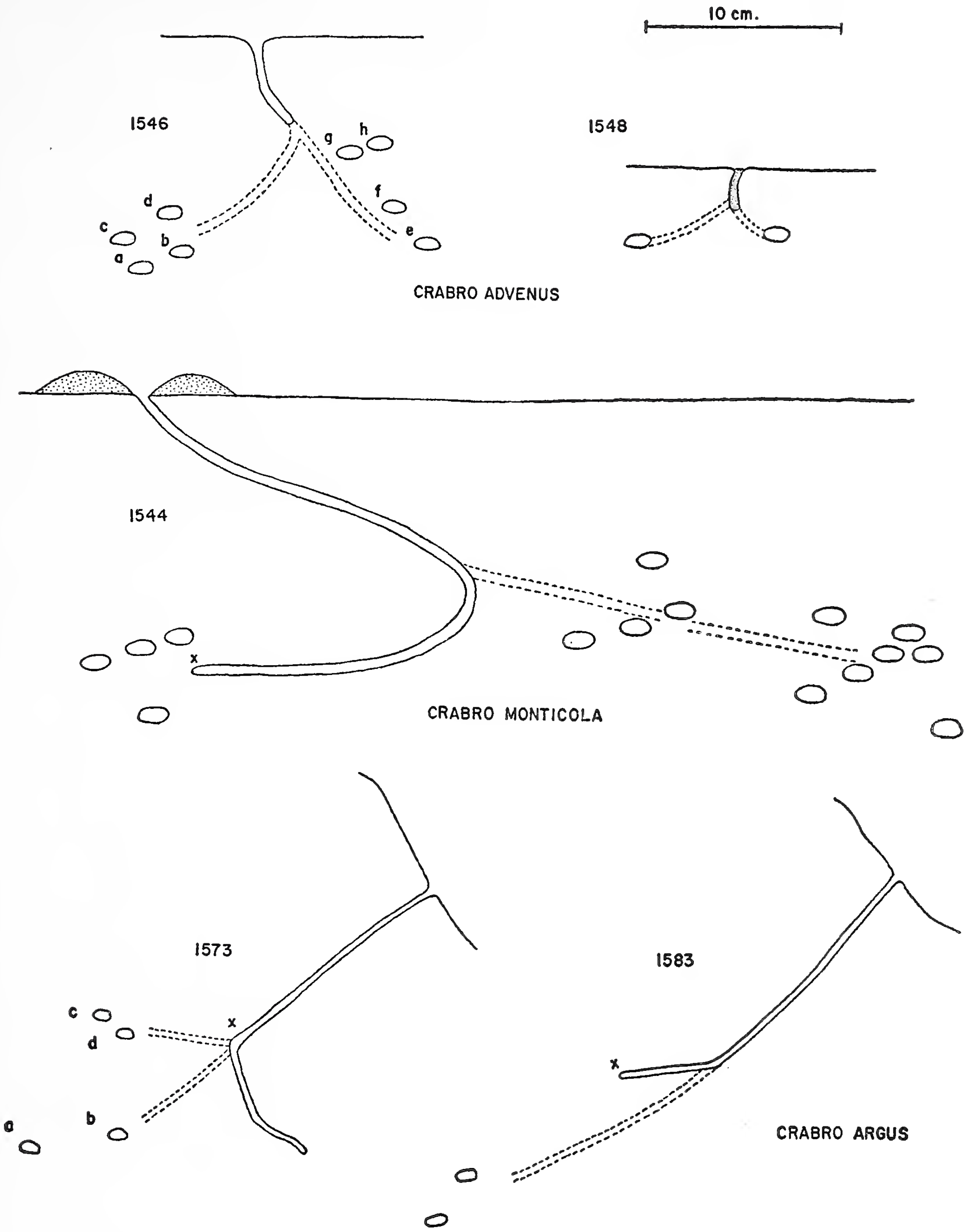

FIG. 1. Nests of three species of *Crabro*. Burrows indicated by dashed lines had been filled with soil and could not be traced exactly. The letter *x* indicates a place in the burrow where flies were found. The two branches of nest no. 1544 (*monticola*) actually formed about a 30° angle with one another; in the drawing this angle has been increased to 180° in order to avoid the need for a three-dimensional drawing.

burrow. From their contents it could be deduced that the wasp had prepared the first cell at the bottom of the burrow, then three additional cells back toward the entrance; she had then filled up this portion of the burrow and dug another branch which eventually contained four more cells, again with the first one deepest, the others progressively back toward the entrance. For example, cell *c* contained a fully grown larva, cell *d* a smaller larva, cell *f* a very small larva, and cells *g* and *h* eggs. In cells *a, b,* and *e* no egg or larva was found; cell *b* contained a small carabid larva, and this or another predator may have destroyed the egg or larva in these cells. The cells were broadly elliptical, nearly horizontal, measuring about 14 mm. long and 7 mm. in diameter. Each cell was packed tightly with flies, most of which were venter-up; however, the first fly placed in the cell (which bore the egg) tended to be placed obliquely against the deep end of the cell, while the last fly placed in the cell was often venter-down. The number of flies per cell varied from four to seven, and all appeared to be dead. The egg was found to be about 2 mm. long, whitish and slightly curved. One end of the egg is glued to the back of the head ventrally, while the other end extends obliquely backward over the venter of the thorax. The larva apparently begins feeding through the membranous areas about the mouthparts or in the neck region. The larva reaches maturity after only five days of feeding.

Only one other nest in this immediate area was marked and dug out; this nest (No. 1547) contained but a single cell, at a depth of 5 cm. Another nest was found on July 6 on the edge of the lawn, about 30 meters away and again in rather hard soil (Fig. 1, No. 1548). This nest was found to contain two cells which were widely separated, one 3 and one 3.5 cm. deep; the burrow had been closed and presumably two was the full complement of cells in this nest. This individual, like the others, was most active in the evening, although at least one fly was brought in at 10:00 A.M.

The 43 flies taken from the various cells of the three nests belonged to six species of as many families. Individual cells usually contained a mixture of species, although a few contained nothing but *Fannia*. The following is a list of the flies and the numbers of each:

RHAGIONIDAE: *Chrysopilus proximus* (Wlk.)	2
TABANIDAE: *Chrysops univittata* Macq.	1
OTITIDAE: Genus and species?	1
MUSCIDAE: *Fannia scalaris* Fabr.	22
CALLIPHORIDAE: *Pollenia rudis* (Fabr.)	12
SARCOPHAGIDAE: *Opelousia obscura* Tns.	5

Patton (1897) reported briefly on the biology of this species. He found the species forming "small hillocks under the shelter of shade trees late in August, in Connecticut." He found the prey to consist of *Musca domestica* L., *Sarcophaga* sp., and *Belvosia unifasciata* Desv. The last-named fly is a tachinid which attacks the armyworm, and Patton therefore described *Crabro advenus* as "a protector of the army worm" and suggested destroying it by "pouring strong alkaline washes into the burrows."

Crabro monticola Packard

On June 28, 1958, while collecting insects in flat, open sandy country at North Haven, Conn., I discovered three nests of this larger species of *Crabro*. The nest entrances stood out very prominently, as each was surrounded by a mound of sand about 2 cm. high and 10 cm. in diameter, with the nest entrance in the center. No activity was observed at any of the nests; two of them had the entrance open, the third closed. I dug out the one with the closed entrance and found the female deep in the nest, 40 cm. from the entrance, and captured her for identification.

This nest contained a total of 15 cells which varied in depth from 7.5 to 17.5 cm., in distance from the entrance from 25 to 45 cm. (Fig. 1, No. 1544). The burrow, although long, obviously did not penetrate the soil deeply. At the end of the burrow was a single paralyzed fly; nearby was a cluster of four cells, all packed with flies, three containing eggs and one (the terminal one) a small larva. The remaining 11 cells were arranged in such a manner that they had obviously been constructed off from another major branch of the burrow which had since been filled. The five deepest cells contained cocoons, the next four large larvae, and the last two smaller larvae. Clearly this species, like *advenus,* builds its cells progressively back toward the entrance and may construct a second major branch of the burrow when the area around the first is used up.

The cells of this species were found to measure about 8 by 17 mm.; they are broadly elliptical and nearly horizontal. No cells were found in series, but some were no more than 2 cm. apart. The flies were packed in the cell venter-up, the last one sometimes venter-down. The number of flies per cell varied from 3 to 5. The egg is laid on the first fly placed in the cell; one end of the egg is glued to the middle of the back of the head, the remainder of the egg extending laterad between the eyes and the prothorax ventrally. The newly hatched larva first feeds through a hole cut through the membranous parts of the mouthparts. Only five days are required for the larva to reach maturity.

All flies taken from cells appeared to be dead. The following three species of flies were represented in the numbers stated:

TABANIDAE:	*Tabanus lasiophthalmus* Macq.	25
	Chrysops celer O.S.	1
THEREVIDAE:	*Thereva* sp.	1

With the exception of one specimen of *Tabanus lasiophthalmus*, all of these flies were males. The cells containing large larvae or cocoons also contained the remains of many additional specimens of *T. lasiophthalmus*.

A second nest (No. 1545), only about two meters away, was also dug out. The entrance to this nest was open, but no adult was found in association with the nest. This nest contained 11 cells which varied in depth from 11 to 20 cm. Ten of these cells contained cocoons, the eleventh only decomposed flies. Each cocoon was surrounded by the wings of flies, and all the wings noticed appeared to be those of *Tabanus lasiophthalmus*.

The cocoons of this species are broadly elliptical and measure about 6.5 by 15 mm. They are fragile, consisting of little more than a single layer of sand grains which have been cemented together. From the outside they appear rough, since the sand grains differ in size and shape. From the inside, the wall of the cocoon is smoother and distinctly shining, as if coated with brown shellac; it is somewhat translucent as a result of light passing through the sand grains. There is little evidence of silk in the walls of the cocoon, although there may be some fibers in the matrix between the sand grains.

On July 28, 1959, Dr. and Mrs. Henry Dietrich of Cornell University found a large nesting aggregation of *Crabro monticola* at

Echo Lake, Mt. Desert Island, Maine. There were perhaps as many as 100 nests, all in flat sandy soil and most of them in a well-traveled path. Each nest entrance was surrounded by a prominent mound of sand. Although the wasps usually entered their nests very quickly with their flies, on many occasions the nest entrances were damaged or covered by persons walking along the path. Wasps which could not gain entry into their nests frequently left their flies on the ground and did not touch them again. The Dietrichs caught several of the wasps and picked up several of the flies from the ground. The flies, all males, belonged to two species:

TABANIDAE:	*Stonemyia tranquilla* O.S.	2
	Tabanus microcephalus O.S.	8

It is interesting to note that both *Tabanus microcephalus* and *T. lasiophthalmus* are hairy-eyed species (subgenus *Hybomitra*). It is also interesting that in two widely separated localities male tabanids were used almost exclusively. Presumably the hunting behavior of *Crabro monticola* is such that males of this group of tabanids are encountered more than any other flies.

Crabro argus Packard

During the period July 9–August 16, 1958, I found this species nesting in considerable numbers in a sand-bank near Six-mile Creek, Ithaca, N. Y. About 25 nests were marked during this period, and 13 of these were eventually dug out; however, the total number of nests was probably in excess of 50. Individual females appeared to make a series of successive nests, spending only a few days with each. All nests were constructed in rather fine-grained sand on the two sides of a small erosional draw in the sand-bank; the slope of the sides varied from 20 to 80 degrees, and there seemed to be no particular preference for any special degree of slope. The nests tended to be widely scattered over the available space, and in only a few cases were active nests found closer together than half a meter.

One female (No. 1569) began a nest at 11:00 A.M. on August 2. Selecting a place where the slope was about 40°, this female began loosening earth with her mandibles and pushing it out with her legs. By twisting the body first to one side and then the other, and sometimes assuming an inverted position, she succeeded in boring into the bank at about a 90° angle with the slope

of the bank. Five hours later fresh sand was still being pushed out the entrance, indicating that several hours are required to complete the burrow. The sand which is pushed out merely accumulates at the entrance or rolls down the bank; it is not leveled by the wasp. The entrance to the nest is never closed at any time by the wasp, although it sometimes becomes blocked by the slippage of sand from above, particularly following a rain.

Having completed the burrow, the female captures a number of flies which are stored in the burrow (usually at the bottom). Only after the accumulation of a number of flies is a cell constructed and the flies placed in it. For example, No. 1559 was observed bringing flies into a relatively new nest on July 25. When this nest was dug out it was found to contain five fresh flies at the bottom of the burrow, but no cells. No. 1570 was observed bringing in flies during the morning and afternoon of August 2; when this nest was dug in the evening it was found to contain one fully provisioned cell plus one additional fly in the bottom of the burrow. No. 1573 (see fig. 1) was found to have four fully provisioned cells; there were five fresh flies in the burrow which had not yet been placed in a cell.

Provisioning may occur at any time of day, occasionally as late as 7:00 P.M., but is at its peak on sunny days between 10:00 A.M. and 1:00 P.M. Females enter the nesting area only 15–30 cm. high with a flight characterized by rapid side-to-side undulations. As they approach the nest their forward flight slows down and the swerving from side to side becomes more marked; once over the entrance they plunge rapidly into it. The fly is held tightly beneath the body, probably by both middle legs. When pursued by miltogrammine flies, females laden with prey back up in flight slowly, with pronounced side-to-side movements. Sometimes they back up several meters, the miltogrammine following, face-to-face with the wasp. Eventually the wasp darts forward very quickly and regains the nesting area, only to back up again if the miltogrammine is still in pursuit. The miltogrammine flies in question all belonged, I believe, to the genus *Senotainia* (see further discussion of parasites below).

The burrow of *Crabro argus* is very small, only about 3 mm. in diameter, and is generally at about a 90° angle with the sand surface. Most burrows are nearly straight at least for a considerable distance from the nest entrance; at the bottom there

may be various kinks and side-burrows associated with the cells. Cell depth (measured from the entrance rather than from the soil directly above) varied from 18 to 35 cm. (average 27 cm.). The cells are very small, measuring about 6 by 9 mm. Most of the nests dug out contained but one cell, but three contained two and one contained four. In the nest containing four cells (No. 1573; fig. 1) the female was apparently preparing a fifth cell; there were several flies in the burrow at *x* which would presumably have been used to provision the fifth cell. No. 1583 (also figured) is a typical two-celled nest; in this nest there were also flies in the burrow at *x,* indicating that a third cell would eventually have been prepared. However, it is probable that the total number of cells per nest is never very large. Of the nests that were marked, only one was still active after as long a period as four days. Some tendency was noted for cells to be constructed progressively back toward the entrance, as in *advenus* and *monticola.* For example, in nest No. 1573 (see figure) cells *a* and *b* appeared to be older cells (each contained maggots of miltogrammine flies) while cells *c* and *d* appeared to be fresh cells (each contained a wasp egg). Within a given nest, the cells tended to be separated by from 2 to 4 cm. Since the burrow and cells are very small in relation to their depth, it was often difficult to determine the exact relationship of the cells to one another; in fact, a number of cells were undoubtedly overlooked in my excavations.

The number of flies in fully provisioned cells varied from 10 to 19 (average 15); needless to say the number of flies was related to the size of the flies, since the wasp merely packs the cell full. Most of the flies are placed in the cell venter-up, but the top few flies may be on their sides or even dorsum-up. The egg was invariably found on the fly deepest in the cell. The egg is about 2.3 mm. long, and is laid with its anterior end pressed against the ventro-posterior part of the fly's head, the remainder of the egg extending free.

Seventy-nine flies taken from cells or from wasps were found to represent 15 species belonging to three families. In some cases the flies in individual cells were well mixed, in other cases they represented one or a few species. The following is a list of flies found to be used as prey by this wasp:

DOLICHOPODIDAE

Argyra albicans Lw. 2

A. calceata Lw.	1
Dolichopus coercens Wlk.	1
D. gladius VanD.	1
Hercostomus barbatulus Lw.	3
H. crassicauda Lw.	6
H. frequens Lw.	8
H. ornatus VanD.	13
Liancalus genualis Lw.	3
Plastoneurus vagans Lw.	17
EPHYDRIDAE	
Parydra bituberculata Lw.	10
P. borealis Cr.	1
P. breviceps Lw.	4
MUSCIDAE	
Lispe albitarsis Stein	7
L. nasoni Stein	2

Crabro argus was attacked by two miltogrammine flies in this area. The flies which were commonly seen pursuing provisioning wasps appeared to belong to the genus *Senotainia*. One which was captured was identified as *S.* sp. nr. *trilineata* Wulp. There were four maggots in cell *b* of nest No. 1573 which may have represented this species, although they were not reared successfully. Cell *a* of this same nest contained a single large maggot which, in a rearing tin, actually moved about very actively and devoured a medium-sized *Crabro* larva in a neighboring cell. This maggot was successfully reared and the adult identified as *Phrosinella ?fumosa* Allen. Allen (1926) says that dissections of one species of this genus "indicate that they deposit large, active maggots. The female of this species [*fulvicornis* Coq.] has also been observed digging a pit in the sand near the burrow of fossorial Hymenoptera, for which its flattened fore tarsi are admirably adapted. Larvae were deposited in the pit. It seems probable that from this point, they burrow through the soil to the cell of their host. . . ."

Published information on *Crabro argus* consists of two host records. Hartman (1905) remarks that this species confines itself to a single species of the genus *Dolichopus*. Dow (1930) records a specimen from White Plains, N.Y., taken with the dolichopodid fly *Rhaphium vanduzeei* Curran.

DISCUSSION

Obviously there are too many unanswered questions regarding the nesting behavior of these three species to permit a detailed comparison. There are, however, several gross differences which deserve consideration (Table I). It should be pointed out that in

TABLE I

A COMPARISON OF SOME ASPECTS OF THE NESTING BEHAVIOR OF THREE SPECIES OF *Crabro*

Species	Nesting site	Type of prey	Cells per nest	Cell size	Distance of cells from entrance
advenus	Flat, heavy soil	Chiefly Muscoidea	Several (2–8)	7 × 14 mm.	6–12 cm.
monticola	Flat sand	Chiefly Tabanidae	Many (11-15)	8 × 17 mm.	25–45 cm
argus	Sloping sand-banks	Chiefly Dolichopodidae, Ephydridae	Few (1–5)	6 × 9 mm.	18–35 cm.

each case (if one includes published records) the generalization regarding type of prey is based on populations from more than one locality. It can hardly be doubted that these species hunt for flies in different ecological situations. They also nest in different situations, and here again (except for *argus*) there are records for more than one locality. Differences in nest depth, as is generally the case, reflect differences in soil type and in size of the wasp. The manner of flight of provisioning females of *argus* seems to be distinctive, and this species appears to grasp the prey more tightly than does *advenus*, though these points need further study.

Otherwise, one finds these wasps to be very similar in their nesting behavior. The flies are apparently killed by the sting of the wasp. They are carried to the nest beneath the body of the wasp, apparently held by one or both of the wasp's middle legs. Generalizing about the British species, Hamm and Richards (1926) state that "in flight the prey, with its ventral surface uppermost, is gripped round the neck by the right or left middle tibia; as the *Crabro* enters its burrow the prey is passed back to the hind legs and held by the spurs at the end of the tibiae."

Whether this statement is generally applicable to the American species is uncertain.

All three species leave the nest entrance open during periods of provisioning, and plunge headlong into it with their flies. Two of the species (and probably all three) store the flies in the burrow before preparing a new cell and placing them in it. The egg is always laid on the throat of the first fly placed in the cell. Iwata (1942) terms this the "*Crabro*-type" of oviposition and presents several figures (46–50) which closely approximate the manner of oviposition of the three species under consideration.

The Raus (1918) studied another North American species of *Crabro, cingulatus* Packard, in Missouri. This species resembles *argus* in that it makes long, slender burrows in sand-banks and preys on Ephydridae. As in other species of the genus, the prey is killed by the sting. The nest entrance is left open during provisioning, and the flies are allowed to accumulate in the burrow before being placed in a cell. They found from two to eight cells per nest, each cell containing from 11 to 20 flies. Hamm and Richards (1926) present a review of the species occurring in Britain, *cribrarius* Fabricius, *peltarius* Schreber, and *scutellatus* Fabricius. These three species all nest in flat sand, the first two preying chiefly upon Muscoidea, the last upon Dolichopodidae; in most details they closely resemble the North American species.

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UNDESCRIBED SPECIES OF CRANE-FLIES FROM THE HIMALAYA MOUNTAINS (TIPULIDAE, DIPTERA), V*

BY CHARLES P. ALEXANDER
AMHERST, MASSACHUSETTS

The preceding part under this general title was published in the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY, **67**: 223–235. Virtually all of the species here considered were taken in the western Himalayas, in Kumaon, Uttar Pradesh, India, by Dr. Fernand Schmid, to whom my sincere thanks are given for this cooperation. A few other species or records are acknowledged in the text. Types of the novelties are in my private collection of crane-flies.

Neolimnophila bifusca new species

Size medium (wing of male 7 mm.); general coloration of head and thorax gray, the praescutum with four poorly indicated brown stripes; wings whitish subhyaline, suffused with brown in the costal field and over the basal half of cell *Cu*; macrotrichia of veins sparse, lacking on *Sc* and R_{2+3+4}; vein R_2 shortly beyond the fork of R_{2+3+4}; male hypopygium with two subbasal spines on the basistyle, slender and only slightly unequal in size.

MALE. Length about 6 mm.; wing 7 mm.

Rostrum and palpi black. Antenna black throughout. Head gray; anterior vertex broad.

Pronotum gray. Mesonotal praescutum gray, clearer laterally, with four poorly indicated brown stripes, the intermediate pair more widely separated behind; posterior sclerites of notum gray, the scutal lobes vaguely patterned with brown. Pleura gray. Halteres pale yellow. Legs with coxae yellow, the bases of the fore and middle pairs slightly darkened; trochanters yellow; remainder of legs brownish black, the femoral bases a little paler. Wings whitish subhyaline, cells *C* and *Sc* and the basal half of cell *Cu* weakly infuscated; veins yellow, a little darker in the clouded parts. Veins R_3, R_4, distal section of R_5 and all outer branches of *M* with sparse but long macrotrichia, these lacking on *Sc*, R_{2+3+4}, *Rs* and the Anal veins. Venation: Sc_1 ending shortly beyond the fork of *Rs*, Sc_2 near its tip; R_2 shortly beyond the fork, leaving a short element R_{2+3}; cell M_1 about two-thirds its petiole; cell *1st* M_2 long and narrow; *m-cu* about one-half its length beyond the fork of *M*.

* Contribution from the Entomological Laboratory, University of Massachusetts.

Abdomen dark brown. Male hypopygium with two strong spines near base of the basistyle, longer and more slender than in some allied species; outer spine only a trifle shorter and smaller than the inner one.

Holotype, ♂, Gangrea, Pauri Garhwal, Kumaon, 7500–10,000 feet, June 15, 1958 (Schmid).

Neolimnophila bifusca is quite distinct from *N. genitalis* (Brunetti) in the patterned wings. In the latter feature it agrees more closely with other central Asian species, as *N. fuscinervis* Edwards and *N. picturata* Alexander, differing in the wing pattern and trichiation. It is certain that important characters are available in the vein trichiation in this genus.

Crypteria basistylata new species

Size small (wing 5.5 mm. or less); thorax uniformly light yellow, abdomen brownish black, basal sternites obscure yellow; halteres and legs white or pale yellow; wings milky white, veins basad of cord very pale; male hypopygium with the basistyles very long, arcuated or bent at near midlength; dististyles terminal, very small, the outer with appressed teeth on margin before the long terminal spine.

Male. Length about 3–3.5 mm.; wing 5–5.5 mm.

Rostrum brownish yellow; palpi brown. Antennae short; scape obscure yellow, remainder of organ dark brown to brownish black; fusion segment elongate, involving five segments, without constrictions or incomplete subsegments. Head light gray; anterior vertex broad.

Pronotum slightly infuscated above. Mesothorax uniformly light yellow; vestiture of pronotum and praescutum long but very sparse. Halteres long, white. Legs very pale yellow, outer tarsal segments darker. Wings milky white; most veins beyond cord weakly darkened, the remainder concolorous with the ground and scarcely visible in balsam slide mounts. Microtrichia of cells exceedingly reduced in size, visible only under very high magnification; long but sparse macrotrichia on several veins beyond cord, including R_3, R_4, R_5, all outer medial branches and the distal section of Cu_1. Venation: Sc_1 ending about opposite or beyond two-thirds the length of R_{2+3+4}; R_{2+3} arcuated, closely approaching R_1, as in the genus; basal section of R_5 shortened in some specimens, in cases *r–m* before the fork of *Rs;* cell M_1 subequal to or longer than its petiole; *m–cu* at or close to fork of *M*; vein *2nd A* relatively short, ending about opposite the origin of *Rs.*

Abdominal tergites and hypopygium brownish black; basal sternites obscure yellow, outer segments darkened. Male hypopygium with the basistyle very long, strongly bent to weakly hinged at near midlength. Dististyles terminal, very small in comparison with the basistyle; outer style slender, only slightly arcuated, terminating in a long straight point, the outer surface with appressed spines, the outer one longer and more conspicuous; inner style pale, arcuated, the apex slightly bilobed, with delicate setulae and fewer scattered punctures. Phallosome small and simple; gonapophyses appearing as simple slender black rods, narrowed to acute tips, in slide mounts decussate across the midline.

Holotype, ♂, Tapoban, Pauri Garhwal, Kumaon, 7300 feet, August 2, 1958 (Schmid). Allotopotype, ♀, pinned with type. Paratopoptypes, 2 ♂♂; paratypes, ♂♀, Dakwani, Pauri Garhwal, 9300–11,000 feet, August 5, 1958; ♂, Kulara, Pauri Garhwal, 12,000 feet, August 4, 1958 (Schmid); ♂, Yadang, Sikkim, 10,600 feet, June 9, 1959, in *Rhododendron* area (Schmid).

The only previously described regional species is *Crypteria claripennis* (Brunetti), described from the northeast Indian frontier, quite distinct from the present fly in the coloration of the body and legs. Edwards later examined typical material and reported *claripennis* as being very close to the genotype, *C. limnophiloides* Bergroth, of northern Europe. The present fly and the one next described are more nearly allied, differing very evidently in the structure of the male hypopygia. The great reduction in size to virtual loss of the wing microtrichia in the present fly is noteworthy.

Crypteria haploa new species

Size medium (wing of male to 7 mm.); general coloration of thorax yellow, praescutum with ill-defined slightly darker stripes; antennae brownish black; wings whitish subhyaline, the veins comprising the cord slightly darker; male hypopygium with the basistyle relatively short and stout, bearing strong apical and basal lobes, the latter with three powerful bristles; two dististyles, the outer blackened, scabrous; gonapophyses appearing as smooth blackened horns.

MALE. Length about 4.5–5 mm.; wing 6.5–7 mm.; antenna about 1.1–1.2 mm.

FEMALE. Length about 6 mm.; wing 6 mm.

Rostrum testaceous yellow, palpi dark brown. Antennae brownish black; fusion segment involving six segments; outer segments longer than their verticils. Head light gray; anterior vertex very broad.

Pronotum brown. Mesonotal praescutum obscure yellow with ill-defined slightly darker stripes; scutal lobes similarly weakly darkened; posterior sclerites of notum and the pleura clear light yellow. Halteres elongate, pale yellow. Legs with coxae and trochanters yellow; remainder of legs obscure yellow, the outer tarsal segments passing into black. Wings whitish subhyaline, very difficult to see in balsam mounts; veins pale yellow, those comprising the cord infuscated and more evident; in the Sikkim paratype, the ground color slightly darker. Microtrichia of membrane very small but evident under high power. Scattered macrotrichia on veins beyond cord; sparse scattered trichia on outer ends of veins *M*, *Cu* and the Anals. Venation: Veins R_1 and R_{2+3} approximately narrowing cell R_1, as in the genus; cell M_1 longer than its petiole; *m–cu* close to fork of *M*; vein *2nd A* of moderate length, ending shortly beyond the level of origin of *Rs*.

Basal abdominal segments light brown, terminal segment black. Male

hypopygium with the basistyle relatively short and stout, bearing a large apical lobe that is provided with long yellow bristles; a second smaller lobe on mesal face at base, narrowed outwardly, its apex directed caudad, the margin with three powerful fasciculate bristles additional to normal setulae and smaller setae. Two dististyles, an outer straight blackened blade that narrows to an acute point, its surface microscopically scabrous; inner style larger, flattened, produced into a slender point. Phallosome small, including the small triangular aedeagus and larger paired smooth black gonapophyses.

Holotype, ♂, Kulara, Pauri Garhwal, Kumaon, 12,000 feet, August 3, 1958 (Schmid). Allotopotype, ♀, pinned with type. Paratopotypes, ♂♀, with the types; paratypes, 2 ♂♂, Dakwani, Pauri Garhwal, 7300–11,000 feet, August 5, 1958; ♂, Tapoban, Pauri Garhwal, 7300 feet, August 2, 1958; ♂, Thomphyak, Sikkim, 12,800 feet, May 29, 1959 (Schmid).

The most similar related species is *Crypteria basistylata* new species, from the same general area of the Himalayas, readily told by the quite different male hypopygium.

Trentepohlia (Mongoma) argopoda new species

Size medium (wing of male about 6 mm.); general coloration of mesonotal praescutum light brown, posterior sclerites and pleura brownish yellow; legs light brown, tips of tibiae and the tarsi snowy white; fore and middle femora with sparse small spinoid setae; wings tinged with gray; cell *1st* M_2 of moderate size, not exceeding the distal section of vein M_3.

MALE. Length about 5–5.2 mm.; wing 5.8–6 mm.

FEMALE. Length about 5.5–6 mm.; wing 6–6.6 mm.

Rostrum brown; maxillary palpi brownish black, mouthparts yellow. Antennae brownish black; flagellar segments long-oval, exceeding the verticils. Head brownish black, carinate; anterior vertex narrow.

Cervical sclerites and pronotum dark brown medially, paler on sides. Mesonotal praescutum light brown, only slightly darker medially; scutal lobes light brown, the central area yellowed; posterior sclerites of notum obscure brownish yellow. Pleura yellow to brownish yellow. Halteres with stem dirty white, narrowly yellowed at base, knob infuscated. Legs with coxae and trochanters testaceous yellow; femora and tibiae light brown, the latter paling outwardly to snowy white, on the posterior legs including about the distal fifth or sixth; tarsi snowy white; fore and middle femora near bases with a few small erect spinoid setae, lacking on posterior legs; a conspicuous black seta at tip of posterior tibia; a grouping of darkened suberect setae at proximal end of posterior basitarsus, less conspicuous on the middle legs. Wings tinged with gray, stigma small, barely indicated; veins brown. Very sparse scattered trichia on distal section of vein R_5. Venation: R_2 at or shortly before the fork; cell *1st* M_2 of moderate length,

subequal to or shorter than the distal section of M_3; apical fusion of veins Cu_1 and *1st A* short to punctiform.

Abdominal tergites and hypopygium brown; basal sternites light yellow, at about midlength of abdomen in male passing into brown, in female, sternites more extensively yellow.

Holotype, ♂, Gwaldani, Pauri Garhwal, Kumaon, 6000–6400 feet, August 26, 1958 (Schmid). Allotopotype, ♀, pinned with type. Paratopotypes, 2 ♂♂, 1 ♀, August 24–26, 1958; paratype ♀, Tarak Tal, Pauri Garhwal, 7940 feet, August 14, 1958 (Schmid).

The nearest regional ally is *Trentepohlia* (*Mongoma*) *bombayensis* Edwards, from lowland west India, which has the tips of the tibiae and the tarsi pale but not whitened and with cell *1st* M_2 elongate.

Trentepohlia (Mongoma) horiana new species

Size large (wing of female over 8 mm.); general coloration pale yellov to yellowish brown, unpatterned; halteres and legs yellow throughout; vein: Cu_1 and *1st A* narrowly separated at wing margin.

FEMALE. Length 9–11 mm.; wing about 8.2–9 mm.

Rostrum and palpi brownish yellow. Antennae relatively long, if ex tended backward reaching to beyond the wing root, brownish yellow flagellar segments subcylindrical, longer than the verticils. Front and orbit light gray, vertex brown.

Mesonotum almost uniform pale yellowish brown to yellow, the praescutur unpatterned, pleura somewhat clearer yellow. Halteres yellow. Legs yello throughout. Wings subhyaline; veins yellow, faintly distinguishable agains the ground. Veins beyond cord with abundant macrotrichia. Venation Vein R_2 connecting with R_{3+4} at the fork or on vein R_3 immediately beyon base to form a very short vertical element R_{2+3}; cell *1st* M_2 relatively larg about equal to vein M_4; veins Cu_1 and *1st A* narrowly separated on win margin; cell *2nd A* very broad.

Abdomen pale yellow to light brown, in the latter case the color pre sumably abnormally darkened. Ovipositor with the cerci long and slende gently upcurved.

Holotype, ♀, about Hurst Cottage, Bakrota Hill, Dalhousie Punjab, Pakistan, Station M, 7000 feet, May–June 1927 (S. L Hora), at light; in collection of Zoological Survey of India Paratypes, 2 ♀♀, Khunyara, Pauri Garhwal, Kumaon, 4300–500(feet, May 4, 1958 (Schmid).

Named in honor of the collector, Dr. Sunder Lal Hora, distin guished former Director of the Indian Museum. The closest rela tive is the much smaller *Trentepohlia* (*Mongoma*) *flava* (Bru

netti), which has cell *Cu* of the wings even more widely open at the margin. It is further told by the darkened femoral tips and by the reduction in number of macrotrichia of the wing veins.

Trentepohlia (Mongoma) varipes new species

Size relatively large (wing of male 9 mm.); general coloration of entire body yellow; mouthparts, antennae and halteres yellow; legs with femora yellow, tips conspicuously blackened, tibiae dark brown, tarsi brownish black; wings yellow, the costal region and stigma more saturated yellow; apical fusion of veins Cu_1 and *1st A* very short.

MALE. Length about 10 mm.; wing 9 mm.

Rostrum and palpi pale yellow. Antennae light yellow, the outer flagellar segments a trifle darker; flagellar segments subcylindrical, exceeding the verticils in length, outer segments progressively lengthened. Head yellow.

Thorax yellow throughout. Halteres yellow. Legs with the coxae and trochanters pale yellow; femora yellow, tips conspicuously blackened, the amount subequal on all legs, on posterior pair including about the outer tenth; tibiae dark brown, darker outwardly; tarsi brownish black. Wings yellow, the costal region and stigma more saturated yellow; veins deeper yellow. No macrotrichia on *Rs* or basal half of R_{2+3+4}; macrotrichia on R_4, R_5 and distal section of M_{1+2}. Venation: Basal section of R_5 short, subequal to basal section of M_{1+2}; R_2 at fork of R_{3+4}; R_3 faint; *m–cu* at fork of *M*; apical fusion of veins Cu_1 and *1st A* very short.

Abdomen fulvous yellow, including the hypopygium, sternites somewhat clearer yellow.

Holotype, ♂, Gawana, Teri Garhwal, Kumaon, 6020 feet, May 24, 1958 (Schmid).

Trentepohlia (*Mongoma*) *varipes* is quite distinct from all other generally similar regional species in the striking pattern of the legs. The closest allies include *T.* (*M.*) *butleri* Alexander, *T.* (*M.*) *kempi* (Brunetti) and *T.* (*M.*) *splendida* (Brunetti).

Trentepohlia (Trentepohlia) camillerii new species

Size small (wing of male 5 mm.); head and thoracic dorsum yellow, pleura darkened dorsally, forming a broad stripe that is continued backward onto the postnotum; antennal flagellum and legs yellow; knobs of halteres infuscated; wings whitened, with three irregular brown crossbands, the outer two variegated by large ground areas; abdominal segments pale, more darkened basally, subterminal segments dark brown, hypopygium yellow.

MALE.—Length about 4.8 mm.; wing 5 mm.

Rostrum yellow, palpi black. Antennae with scape and pedicel brown, flagellum yellow; flagellar segments elongate-subcylindrical, with short verticils. Head light yellow in front, more brownish yellow on posterior vertex and genae.

Cervical region darkened. Pronotum and mesonotum light yellow, un-

patterned. Pleura light yellow, with a broad brown dorsal stripe, widened behind, passing beneath the halteres onto the postnotum. Halteres with stem light yellow, knob infuscated. Legs light yellow. Wings with the ground whitened, the base and costal region light yellow; a conspicuous brown pattern, arranged chiefly as three bands that are separated by broad complete ground areas; basal band narrow, postarcular, crossing the wing from *C* to tip of vein *2nd A*; second band broad, extending from origin of *Rs* to fork of *Sc*, paler behind but reaching the posterior border in the outer third of cell *1st A*, interrupted by large quadrate ground areas in cell R_1 beyond origin of *Rs* and near outer ends of cells *R*, *M* and *Cu*; outer band slightly more extensive, extending from the outer forks to before the wing tip, interrupted by ground areas in cells R_3, R_4, R_5 and M_2; wing tip pale; veins in the interspace pale yellow and inconspicuous, darker in the patterned areas, especially the outer section of vein R_5. Venation: Basal section of M_{1+2} subequal in length to distal section of vein *M*; cell R_5 about four times its petiole; apical fusion of Cu_1 and *1st A* relatively extensive, about one-third *m–cu*.

Holotype, ♂, Saint Marys College, Kurseong, Darjeeling District, West Bengal, India, 5455 feet, September 5, 1958, at light (Camilleri).

I am pleased to name this attractive fly for Father Aloysius Camilleri, S.J., to whom we are indebted for several interesting Tipulidae from the vicinity of Kurseong. The most similar regional species include *Trentepohlia* (*Trentepohlia*) *bellipennis* Alexander, *T.* (*T.*) *ornatepennis* Brunetti, and *T.* (*T.*) *suavis* Alexander, all readily distinguished among themselves by the nature of the wing pattern. The present fly has the ground interspaces broader than in the other species, subequal in area to the darkened bands.

Teucholabis (Teucholabis) diversipes new species

General coloration of body purplish black, polished; rostrum long; knobs of halteres yellow; all legs differing in color, fore femora chiefly black, midfemora entirely yellow, posterior femora yellow, the tip narrowly black; wings tinged with yellow, very restrictedly patterned with brown, including the darker stigma; *Sc* long; ovipositor with basal shield yellowed, cerci long and slender.

FEMALE. Length about 7 mm.; wing 6.8 mm.

Rostrum black, elongate, only a little shorter than the remainder of head; palpi black. Antennae with basal segments brownish yellow, flagellum light brown, the outer segments darker; segments oval, shorter than the verticils. Head black.

Cervical region and extreme anterior end of the pronotal scutum blackened, the remainder of pronotal scutum yellow, scutellum and pretergites black. Mesonotum polished black, with vague purplish reflections; scutellum

light yellow. Pleura polished black, with purplish reflections, dorsopleural membrane more yellowed. Halteres with stem blackened, knob yellow. Legs with all coxae and trochanters yellow; remainder of all legs differently patterned; fore femora black, its proximal third yellow, tibiae brownish black, tarsi black, the proximal third of basitarsi brownish yellow; middle femora and tibiae entirely yellow, basitarsus yellow, the tip narrowly blackened, remainder of tarsi black; posterior femora light yellow with about the outer fifth abruptly black, tibiae yellow, the base narrowly blackened, tarsi brownish yellow, outer segments broken but presumably blackened. Wings tinged with yellow, costal region clearer yellow, especially at near midlength of wing; a restricted brown pattern, including the darker elongate stigma and a narrow seam over the anterior cord; cells R_3 to *Cu* vaguely washed with light brown; veins brown, darker along cord, light yellow in the brightened costal field. Veins of outer two-thirds of wing with abundant macrotrichia, including most of *Rs*, outer two-thirds of *1st A* and virtually all of *2nd A*; *M* with the trichia very small, widely separated on basal half of vein. Venation: *Sc* long, Sc_1 ending about opposite two-thirds *Rs*, Sc_2 at near one-fourth the length of this vein; R_2 subequal to R_{2+3+4}; cells *1st* M_2 and *2nd* M_2 subequal in length; *m–cu* about one-third its length beyond the fork of *M*.

Abdomen black. Ovipositor with the basal shield yellowed; cerci long and slender, brown.

Holotype, ♀, Binaik Chatti, Pauri Garhwal, Kumaon, 7000–7500 feet, June 16, 1958 (Schmid).

Teucholabis (*Teucholabis*) *diversipes* is most similar to *T.* (*T.*) *assamensis* Brunetti, differing evidently in the coloration of the wings and legs.

Rhabdomastix (Rhabdomastix) himalayensis new species

Size large (wing of male about 7 mm.); antennae of male very long, exceeding three times the body or wing; general coloration of thorax dark grayish brown; femora obscure yellow, narrowly darkened at tips; wings very weakly darkened, unpatterned except for the darker brown stigma; veins unusually glabrous; *Sc* long, Anal cells very broad; male hypopygium with the interbase elongate, narrowed very gradually into a hairline point.

MALE. Length about 7 mm.; wing 7.2 mm.; antenna about 26 mm.

Rostrum very reduced, yellow; palpi black; ventral part of head yellow, greatly produced. Antennae of male very long, exceeding three times the wing; scape yellow basally, darkened at tip, pedicel brown, flagellum dark brown; flagellar segments very long, especially the outer ones; vestiture except on basal segments very reduced to virtually lacking. Head above gray; anterior vertex very broad.

Pronotum brownish gray, lateral ends of scutellum more yellowed. Mesonotum almost uniformly dark grayish brown, the praescutal stripes only a trifle darker than the gray interspaces. Pleura dark grayish brown. Halteres obscure brownish yellow, base of stem narrowly yellow. Legs

with fore coxae brown, remaining coxae yellowed; trochanters yellow, fore and middle pairs very long; femora obscure yellow, narrowly darkened at tips; tibiae brown, tips darker; tarsi brown, more intensively so outwardly. Wings very weakly darkened, unpatterned except for the darker brown stigma; veins dark brown, some heavier and more distinct. Veins, with the exception of costa, glabrous. Venation: *Sc* relatively long, Sc_1 ending shortly before level of fork of the long *Rs*, Sc_2 near its tip; vein R_3 slightly oblique, about equal in length to the costal distance between it and R_{1+2}; basal section of M_3 very short, *m* correspondingly lengthened; vein *Cu* conspicuously shirred at *m–cu*; Anal cells very broad.

Abdomen, including hypopygium, dark brown. Male hypopygium with the basistyle simple, narrowed outwardly. Dististyles terminal, united at base; outer style a gently curved club, scabrous on outer half, terminating in a recurved yellow spine; inner style a little longer, very strongly narrowed on outer fourth. Phallosome with a black rodlike structure on either side, articulated with the unusually long interbase, this enlarged on proximal third, thence narrowed very gradually into a hairlike point.

Holotype, ♂, Salkhola, Pauri Garhwal, Kumaon, 4240 feet, August 22, 1958 (Schmid).

Rhabdomastix (*Rhabdomastix*) *himalayensis* is very different from the two previously described Indian species of the typical subgenus, *R.* (*R.*) *nilgirica* Alexander and *R.* (*R.*) *schmidiana* Alexander, the latter differing in the venation, the former in its conspicuously patterned wings. The unusually glabrous wing veins of the present fly are noteworthy.

Rhabdomastix (Sacandaga) almorae new species

Size small (wing 4 mm. or less); general coloration of head and thorax gray, the praescutum with indications of a pair of pale brown stripes; legs brownish black; wings relatively narrow, membrane weakly darkened; macrotrichia of veins reduced in number; *Sc* relatively long, cell *2nd A* narrow; male hypopygium with the outer half of the interbase a long pale blade.

MALE. Length about 3.5 mm.; wing 3.8 mm.

FEMALE. Length about 4–4.2 mm.; wing 4 mm.

Rostrum gray; palpi black. Antennae black, short; flagellar segments oval, a little shorter than their verticils; in the type male the antennae are broken, mounted on a microscope slide, the proximal three flagellar segments incompletely fused. Head gray.

Pronotum and mesonotum clear light gray, the praescutum with vague indications of two pale brown intermediate stripes. Pleura gray, dorsopleural membrane paler. Halteres with stem dusky, knobs more whitened. Legs with coxae and trochanters brownish yellow; femora dark brown, restrictedly paler at bases; tibiae and tarsi brownish black; tibia with an unusually long and stout apical seta that strongly simulates a tibial spur.

Wings relatively narrow; membrane weakly darkened, the prearcular and costal fields more brownish yellow; stigmal region vaguely more darkened; veins brown, those at wing base slightly more yellowed. Macrotrichia of veins sparse, with a few scattered trichia on outer two-thirds of R_5 and M_{1+2}, none on *R* or *Sc*. Venation: *Sc* relatively long, Sc_1 ending nearly opposite midlength of *Rs*, Sc_2 apparently lacking; R_{2+3+4} about one-fourth longer than the gently arcuated R_4; *m* and basal section of M_3 subequal or the latter shorter; *m–cu* at near midlength of M_{3+4}; vein Cu_2 extending to some distance beyond *m–cu*; cell *2nd A* relatively narrow.

Abdomen dark brown, in the male the ninth segment still darker, styli brown. Ovipositor with cerci very long and slender, the outer third gently upcurved. Male hypopygium with the outer dististyle relatively slender, apical point stout; appressed spicules over most of outer surface; inner style very broad, the short narrow apex with a single long bristle, with shorter setae on disk and outer margin. Interbase a little longer than the outer dististyle, constricted beyond base, the outer half slightly expanded into a long pale blade, the tip acute.

Holotype, ♂, Bagheswar, Almora, Kumaon, 3200 feet, September 23, 1958 (Schmid). Allotopotype, ♀, and paratopotype, ♀, pinned with type.

Rhabdomastix (*Sacandaga*) *almorae* is generally similar to other small-sized regional members of the subgenus, including *R.* (*S.*) *emodicola* Alexander and *R.* (*S.*) *teriensis* Alexander, and in the details of structure of the male hypopygium, particu-
differing in the narrow darkened wings, with narrow cell *2nd A*,
larly the interbase.

THE SPECIES OF THE GENUS NEOTEPHRITIS HENDEL IN AMERICA NORTH OF MEXICO (DIPTERA, TEPHRITIDAE)

BY RICHARD H. FOOTE
ENTOMOLOGY RESEARCH DIVISION, ARS,
U. S. DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

No previous attempt has ever been made to summarize information of the species comprising the New World genus *Neotephritis* Hendel. In the present paper I bring together the important taxonomic literature pertaining to *finalis* (Loew) and *inornata* (Coquillett), the species previously known to occur north of Mexico. I also present a short discussion of the host relationships of *finalis* and describe a new species, *rava,* at present known only from Arizona.

The following individuals furnished specimens for study: Marian Adachi, University of Arizona, Tucson; R. S. Beal, Jr., Arizona State University, Tempe; F. L. Blanc and P. H. Arnaud, Jr., California Department of Agriculture, Sacramento; R. R. Dreisbach, Midland, Michigan; B. A. Foote, University of Idaho, Moscow; R. C. Froeschner, Montana State College, Bozeman; A. T. McClay, University of California, Davis; R. L. Post, North Dakota Agricultural College, Fargo; H. G. Rodeck, University of Colorado Museum, Boulder; C. W. Sabrosky, U. S. Department of Agriculture, Washington, D. C.; and G. Wallace, Carnegie Museum, Pittsburgh, Pa. Collections in the U. S. National Museum are also included in this study.

Genus *Neotephritis* Hendel

Neotephritis Hendel, 1935, Konowia 14: 54. Type-species: *Trypeta finalis* Loew, 1862; by original designation.

GENERIC DIAGNOSIS.—Three pairs lower fronto-orbitals; two pairs upper fronto-orbitals, the posterior pair reclinate, not convergent; ocellars at least as long as posterior lower fronto-orbitals. No presutural dorsocentrals; one pair postsutural dorsocentrals, situated closer to transverse suture than to supra-alars; two pairs scutellars. Wing pattern primarily a dark field with rounded hyaline or yellowish-hyaline spots, those immediately distad of stigma close together and forming an inverted triangular area extending from costa to vein R_5; vein R_5 bare at node and beyond.

DISCUSSION.—The genus *Neotephritis* is closely allied morphologically to the following seven genera, all comprising the typical tribe of the subfamily Tephritinae: *Euarestoides* Foote, *Euaresta* Loew, *Tephritis* Latreille, *Paroxyna* Hendel, *Oxyna* Robineau-Desvoidy, *Trupanea* Guettard, and *Dyseuaresta* Hendel. Of these genera, *Euarestoides,* which has three pairs of lower fronto-orbitals, two pairs of upper fronto-orbitals, and two pairs of scutellars, is perhaps most closely related to *Neotephritis.* The two genera may be differentiated by the wing pattern, that of *Euarestoides* having a combination of the dark pre-apical starlike pattern typical of *Trupanea* and lighter basal wing field markings, and that of *Neotephritis* with hyaline spots scattered over a dark field. *Euaresta, Tephritis,* and *Paroxyna,* all having hyaline spots in a dark field, may be distinguished by the presence of only two pairs of lower fronto-orbitals, and *Oxyna* by the presence of only one pair. *Trupanea* and *Dyseuaresta* have only one pair of scutellars.

With the unaided eye, species of *Neotephritis* can be recognized by the large, inverted hyaline triangle based on the costa at the middle of the wing, on each side of which is an oblique dark area. These dark marks have the gross appearance of a Y, with the triangle situated between its arms. This Y mark and hyaline triangle are less evident upon magnification, however, because of the presence of other hyaline spots in the wing disc.

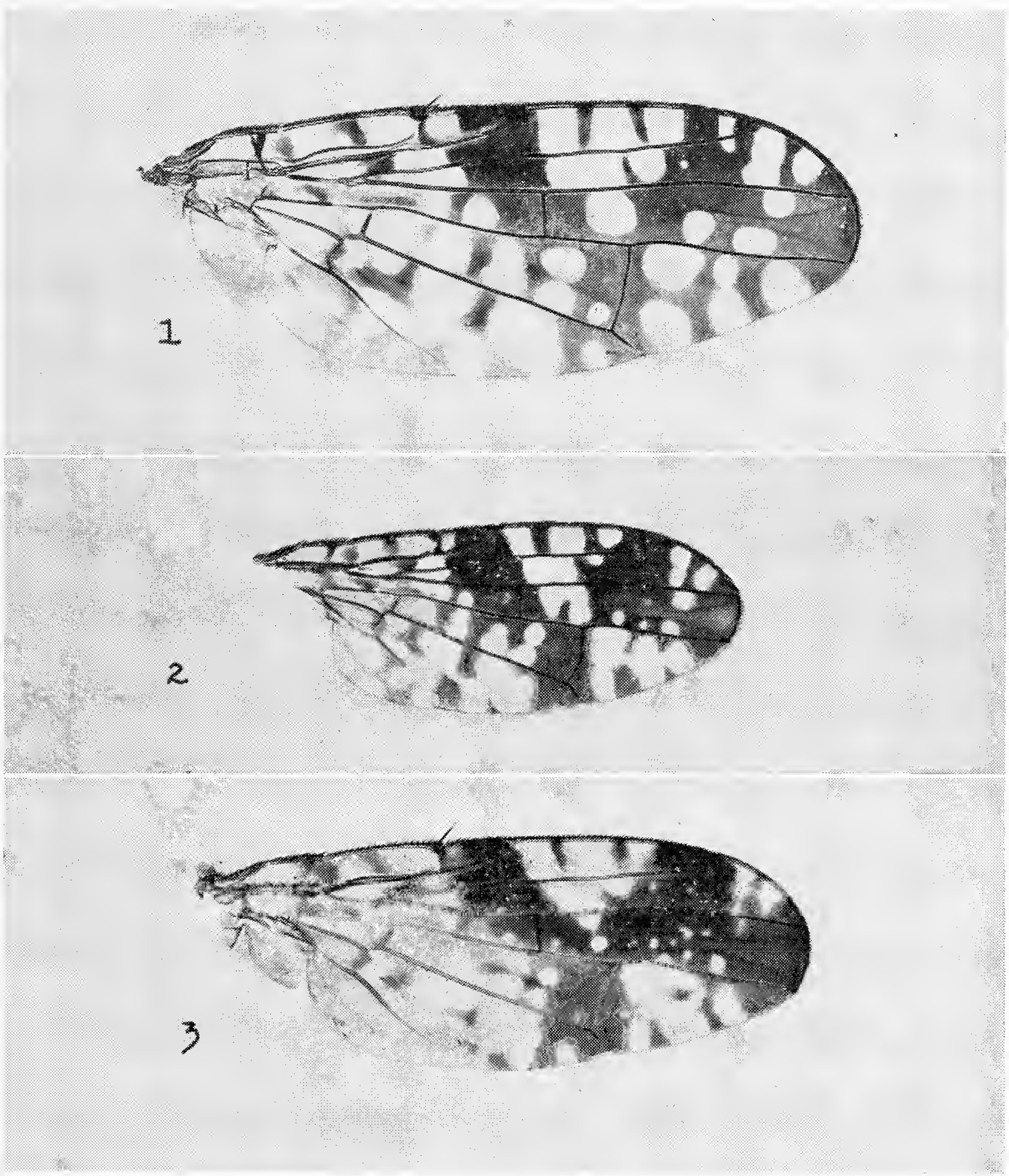
Key to the Species of *Neotephritis* Occurring North of Mexico

1. Two light spots in cell R_5 immediately anterior to vein M_{1+2}; ovipositor sheath darkened at apex .... **finalis** (Lw.)
   Three to five light spots in cell R_5 immediately anterior to vein M_{1+2}; ovipositor sheath darkened only at base or unicolorous 2
2. Mesonotum and abdominal terga grayish; flattened ovipositor sheath about 1.5 times as long as width at base; wing grayish, hyaline spots with distinct margins .... **inornata** (Coq.)
   Mesonotum and abdominal tergites gray with a distinct yellow cast; ovipositor sheath not longer than width at base; hyaline spots of light brown wing with indistinct margins .... **rava**, new species

Neotephritis finalis (Loew)
(Fig. 1)

Trypeta finalis Loew, 1862, Berl. Ent. Ztschr. 6: 222; 1864, Cent. II: 92. Loew, 1873, Smithsn. Misc. Collect. 11(256): 296; pl. XI, fig. 4.

Tephritis finalis: Loew, 1873, Smithsn. Misc. Collect. 11(256): 297, 330. Snow, 1894, Kans. Univ. Quart. 2: 172. Doane, 1899, Jour. N. Y. Ent. Soc. 7: 188. Coquillett, 1899, Jour. N. Y. Ent. Soc. 7: 264. Johnson, 1903, Trans. Amer. Ent. Soc. 29: 106. Snow, 1903, Kans. Univ. Sci. Bul. 2: 219. Snow, 1904, Kans. Univ. Sci. Bul. 2: 345. Aldrich, 1905, Smithsn. Misc. Collect. 46(1444): 611. Cresson, 1907, Trans. Amer. Ent. Soc. 33: 101. Cole and Lovett, 1921, Proc. Calif. Acad. Sci., 4th Ser., 11: 326. Janes and Thomas, 1932, Utah



RIGHT WING, DORSAL VIEW. Fig. 1, *Neotephritis finalis* (Lw.); fig. 2, *N. inornata* (Coq.); fig. 3, *N. rava*, new species.

Acad. Sci. 9: 104. Bissell, 1936, Gardeners' Chron. Amer. 40: 233. Phillips, 1946, Amer. Ent. Soc., Mem. 12: 79, 123; pl. IV, fig. 34; pl. VII, fig. 78; pl. XI, fig. 143.

Trypeta (Tephritis) finalis: Osten Sacken, 1877, Bul. U. S. Geol. and Geogr. Surv. 3(2): 346. Osten Sacken, 1878, Smithsn. Misc. Collect. 16(270): 193.

Euribia finalis: Hendel, 1914, Arb. Berl. Mus. Dresden 14(3): 67. Aczél, 1949, Acta Zool. Lilloana 7: 184.

Neotephritis finalis: Hendel, 1935, Konowia 14: 54. Quisenberry, 1951, Jour. Kans. Ent. Soc. 24: 59. Aczél, 1951, Acta Zool. Lilloana 12: 119.

Tephritis affinis Snow, 1894, Kans. Univ. Quart. 2: 172; pl. VII, fig. 12. Coquillett, 1899, Jour. N. Y. Ent. Soc. 7: 264. Aldrich, 1905, Smithsn. Misc. Collect. 46(1444): 611. Quisenberry, 1951, Jour. Kans. Ent. Soc. 24: 59 (syn.).

Material examined.—Types (♂ and ♀ on one pin) with the following labels: "Cala.," "Loew Coll.," "finalis Lw.," and "Type 13314." In the Museum of Comparative Zoology, Cambridge, Mass. Over 1,000 specimens from about 175 localities were examined for this study. The data below summarize the distribution of *finalis* and indicate for each state the inclusive dates of capture, regardless of year, and the inclusive years in which the dates for each state occurred. ARIZONA: 2.II to 4.XI, 1911–1958. CALIFORNIA: 1.III to 29.VII, 1916–1955. COLORADO: 24.IV to 27.IX, 1900–1952. GEORGIA: 9.VII to 19.X, 1935–1936. IDAHO: 6.IV to 3.X, 1925–1953. KANSAS: 13.IX to 13.X, 1930–1934. MISSOURI: 26.VIII to 18.X, 1927–1938. MONTANA: 29.IV to VIII, 1933–1956. NEBRASKA: 29.VI to 2.IX, 1904–1958. NEVADA: 12 to 17.VII, 1911. NEW MEXICO: 25.VII to 29.VIII, 1894–1952. NORTH DAKOTA: 24.VIII, 1924. OREGON: 4.VI to 8.VIII, 1897–1950. SOUTH CAROLINA: 1932. SOUTH DAKOTA: no data. TEXAS: 18.III to 19.IX, 1905–1958. UTAH: 24.V to 14.VIII, 1911–1956. VIRGINIA: 1930. WASHINGTON: 30.III to 3.IX, 1901–1947. WYOMING: 20.VI to 22.VII, 1895–1941.

Hosts. Bissell (1936) describes an infestation by *finalis* of dahlias grown in a 1935 trial planting at the Georgia Experiment Station. The flies were seen laying eggs between the sepals and petals just as the flowers were beginning to open. The larvae worked down through the petals and congregated on the disc,

where they caused rapid destruction of the ovaries and other flower parts. No mention is made of seed infestation, but seed production must have been affected seriously.

N. finalis has been reared in Oregon from *Eriophyllum lanatum* (Cole & Lovett, 1921), in Utah from seeds of *Helianthella uniflora,* and in Texas from seeds of a plant doubtfully identified as *Actinomeris* sp. Phillips (1946) has called it the sunflower maggot because of its predilection for that plant; adults have been reared from heads of various species of *Helianthus* in many parts of the United States.

Adults have been collected from a number of plants: *Artemisia tridentata, Baccharis sarothamnae, Circium* sp., *Encelia californica, Englemannia pinnatifolia, Lupinus* sp., *Prunus virginiana, Salsola parviflora, S. pestifer, Solanum eleagnifolium, Valciana edulis,* and *Wyethia angustifolia.* They have also been found on artichoke, corn, cotton, alfalfa, peaches, potatoes, and spinach.

DISCUSSION. *N. finalis* is one of the most commonly encountered tephritids in North America. It is easily distinguished from the following two species by the presence of only two round hyaline spots in cell R_5 immediately anterior to vein M_{1+2}, and by the longer ovipositor sheath which is about half again as long as its width at the base and always and distinctly darkened at its tip. *N. finalis* resembles *inornata* closely except for its larger size and the characters discussed under the latter species. For characters distinguishing *finalis* from *rava,* n.sp., see the discussion of that species.

Neotephritis inornata (Coquillett)
(Fig. 2)

Tephritis inornata Coquillett, 1902, Jour. N. Y. Ent. Soc. 10: 181. Aldrich, 1905, Smithsn. Misc. Collect. 46(1444): 612. Cresson, 1907, Trans. Amer. Ent. Soc. 32: 104; pl. I, fig. 5.
Neotephritis inornata: Quisenberry, 1951, Jour. Kans. Ent. Soc. 24: 59.

MATERIAL EXAMINED. Holotype male with the following labels: "Las Vegas H. S., N. M., 2-VIII," "H. S. Barber, Collector," "Type No. 6638, U.S.N.M." [in red], and "*Tephritis inornata* Coq." In the U. S. National Museum, Washington. ARIZONA: 1 ♀, Chiricahua Mts., 9.VIII.58; 1 ♀, Huachuca Mts., 30.X.37;

2 ♂♂, 4 ♀♀, Portal, 7.VIII.58; 6 ♂♂, 3 ♀♀, 5 mi. W. of Portal, 13.VIII.58; 1 ♂, Rustler Park 6.VIII.58. COLORADO: 1 ♀, Colorado Springs, 5915 ft. alt., VIII.08; Ft. Collins, 19.VIII.06 (1 ♀) and 11.VIII.34 (♂, 2 ♀♀); 1 ♂, "University Campus." NEW MEXICO: 1 ♀, Cline's Corners, Albuquerque, 25.VIII.40; Las Vegas Hot Springs, 5.VIII (1 ♀) and 9.VIII (1 ♀); 1 ♂, Raton.

HOSTS. No information available.

DISCUSSION. Coquillett's description (1902, p. 181) of this small, rare species depends upon wing characters to distinguish it from *finalis*. In nearly all specimens of *inornata* I have seen, a small hyaline area of varying extent is present near the apex of the stigma (see fig. 2), and without exception cell R_5 contains three small hyaline spots in a row immediately anterior to vein M_{1+2}. All hyaline spots tend to have less distinct margins than those of *finalis*, and the spots forming the hyaline triangle immediately distad of the stigma are much more closely fused than in that species. The body color of *inornata* is darker gray with less yellow, and the ovipositor sheath, although of about the same proportions as that of *finalis*, is brownish yellow and darkened basally but not apically. Adults of *inornata* are usually smaller than those of *finalis*, but an occasional female may be comparable in size with an average *finalis* male. For characters distinguishing *inornata* from *rava*, n.sp., see the discussion of that species.

Neotephritis rava, new species
(Fig. 3)

A large *Neotephritis*, comparable in size to *finalis* (Lw.), having brownish wings with indistinctly margined hyaline spots and a short, yellow, unmarked ovipositor sheath.

HEAD. Frons brownish yellow, as wide as distance from occiput to lunule, at occiput 1.2 times as wide as one eye; parafrontal with silvery-white pollen in certain lights; in profile face concave immediately above oral margin; eye 1.2 times as high as wide; cheek 0.12 times as high as eye; antenna yellowish with short black hairs; lower fronto-orbital, anterior upper fronto-orbital, ocellar, and vertical dark brown to black; posterior upper fronto-orbital, ocular, and genal pale brown to brownish yellow.

THORAX. Sternopleuron and metanotum dark gray with thin golden pollinosity; humeri, mesonotum and scutellum so heavily golden pollinose that the black ground color is almost completely obscured; entire thorax, especially mesonotum and lateral borders of scutellum, with short, blunt, yellowish hairs in addition to the longer dark brown to black bristles. Legs brownish yellow with thinly scattered gray to silver pollinosity, appearing almost as a bloom; bristles dark brown or black. Halter yellow.

Dark marking of wing as in fig. 3, definitely brown with pattern of hyaline spots typical of the genus; hyaline areas with quite indistinct margins; most hyaline areas distinctly yellowish and represented by fused spots containing various degrees of brown color; basal two-thirds to three-fourths of cell 1st M_2 almost completely yellowish hyaline because of the presence of two rows of fused spots; proportion of length to width of stigma as 13: 5; dark areas in cells R_3 and R_5 with numerous, very small, yellowish hyaline spots.

ABDOMEN. Tergites grayish yellow, subshining, without pattern, covered with black hairs; sternites subshining but with denser gray pollinosity than tergites. Ovipositor sheath shining brownish yellow, completely covered with short, black hairs, flattened sheath almost exactly as long as width at base. Male terminalia shining brownish yellow.

TYPES. Holotype female, Rustler Park, Portal, Arizona, alt. 8200 ft., 3.VIII.55, R. R. Dreisbach. U. S. National Museum Type No. 64827. Paratypes (all Arizona): 3 ♂♂, 2 ♀♀, same data as type (1 ♂, 1 ♀, U. S. National Museum; 2 ♂♂ 1 ♀, Dreisbach Collection); Chiricahua Mts., 12.VIII.37 (1 ♀, Univ. Arizona, Tucson); 7.VIII.55 (1 ♂, 2 ♀♀, U. S. National Museum; 2 ♂♂, 6 ♀♀, Univ. Arizona, Tucson); 1 ♀, 5 mi. W. of Portal, Cochise Co., 28.VIII.57 (Univ. Arizona, Tucson); 2 ♂♂ Rustler Park, 25.VI.53 (U. S. National Museum); Santa Rita Mts., 15.VI.24 (1 ♀, Univ. Arizona, Tucson); 25.X.36 (1 ♀, Calif. Acad. Sci., San Francisco).

HOSTS. No information available.

DISCUSSION. *Neotephritis rava* may be distinguished easily from *finalis* by the yellowish gray color of the body, the brown color of the dark areas of the wing disc and the yellow cast of the hyaline areas, and the shorter, unicolorous ovipositor sheath. Unlike the preceding two species, the hyaline spots in the wing of *rava* are indistinct and tend to fuse with each other in areas where they are close together. The dark areas of cells R_3 and R_5 contain numerous small hyaline spots; these are not present in the other two species of the genus.

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A POSTSCRIPT ON THE ITHOMINE TRIBE TITHOREINI

By RICHARD M. FOX
CARNEGIE MUSEUM, PITTSBURGH, PENNSYLVANIA

Since the publication of a *Monograph of the Ithomiidae (Lepidoptera)*: Part I (Fox, 1956) reviewing the systematics of the tribe Tithoreini, several new matters pertaining to these insects have come to my attention. This information is presented here in order to complete the record to date.

Genus *Patricia* Fox

During a short visit to the British Museum (Natural History) in 1957, I had the opportunity to examine the type specimens of names applying to this genus and to dissect and compare male genitalia. As a result, an additional subspecies was found and some of the previously published synonymy must be revised.

I had recorded (*op. cit.*) as synonyms, *P. oligyrtis* and *P. demylus,* with the observation that the original descriptions were misleading in that they did not touch on points in common, but that the photographs of the type specimens appeared to be of the same species. Examination of the specimens themselves, however, revealed that in *oligyrtis* there is a series of translucent white submarginal spots placed in the distal ends of the cells next to the opaque black borders, but that these are not present in *demylus.* I must conclude that two different species are involved and that the names are not synonyms.

Srnka (1885) noticed that Hewitson (1872 (1852–1876)) had illustrated two different insects as *dercyllidas;* he renamed the second figure *hewitsonii.* Accordingly, the original of Hewitson's figure 2, plate 9 of volume 5 (*op. cit.*) became the type of the Srnka name. This specimen, through oversight, was not set aside in the collection as a type. It is identical with the type of *demylus* Godman and Salvin (1879) and lacks the translucent white spots of *oligyrtis.*

Genitalia were dissected of the type of *hewitsonii,* a male, and of a male "cotype" (paratype) of *demylus.* These were

found to be identical and are exactly like the male genitalia figured (Fox, *op. cit.* fig. 44) for *P. hewitsonii.* The male genitalia for the new subspecies described below also are like this figure; in fact, the specimen in the Museum of Comparative Zoology, which I had previously identified as *hewitsonii hewitsonii*, is a paratype of the new subspecies. The only specimens of *oligyrtis* I have seen are females, so the same criteria could not be applied.

Since three members of the genus fly together in Eastern Ecuador, *P. dercyllidas hazelea, P. demylus demylus* and *P. oligyrtis,* it seems clear that there must be at least three species. The new subspecies is from Bolivia.

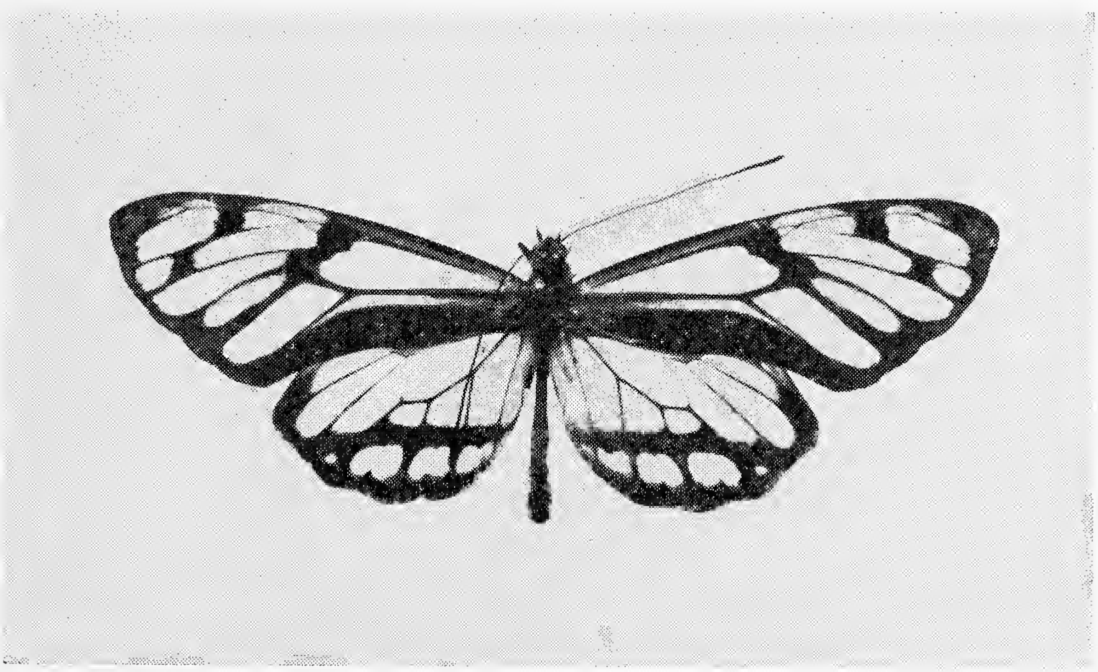

FIG. 1. *Patricia demylus gemellus* new subspecies. Holotype male from Taunas, Bolivia, in the British Museum (Natural History).

Patricia demylus gemellus new subspecies
(fig. 1)

Patricia oligyrtis hewitsonii, Fox 1956 (not Srnka, 1885). Bull. American Mus. Nat. Hist., **111**: 36, 38 (part); fig. 44; plate 2, fig. 6.

The pattern resembles that of *P. demylus demylus* except that the black opaque bands are wider and darker so that the cross bars in R-M_1 and M_1-M_2 of the fore wing and the postmedian band of the hind wing are as wide as or even wider than the

adjacent black borders. The translucent submarginal series of spots on the hind wing are very little if any wider than the black postmedian band or the opaque border and they are of a hue little differing from that of the discal area. Furthermore, in *P. d. demylus* the opaque cross bars of the fore wing and the postmedian band of the hind wing are narrower and often are thinly scaled in part; thus the translucent series of submarginal spots on the hind wing are very much wider than the border or than the postmedian band, and they are obviously more orange-hued than is the hind wing discal area.

The male genitalia agree with those of *demylus* and were previously figured (Fox, *op. cit.*; fig. 44). They differ from the genitalia of *P. dercyllidas* especially in the armament at the end of the valves.

TYPE MATERIAL: Holotype male from Taunas, Bolivia, 5400 feet; Adams bequest 1912–397, in the British Museum (Natural History). A male paratype from Farinas, La Paz, Bolivia, 1500 meters; Joicey bequest 1934–120, in the British Museum (Natural History). A male paratype from Coroico, Bolivia; A. G. Weeks collection in the Museum of Comparative Zoology (identified as *P. hewitsonii* Srnka by Fox, 1954).

The key to the species and subspecies of the genus *Patricia* must be revised to read as follows:

1. Cell M_3-Cu_1 of fore wing entirely black, this coloring continuous with the discocellular band .... (*P. dercyllidas*) 2
   Cell M_3-Cu_1 of fore wing translucent, only the veins black 3
2. Transparent submarginal spot in M_1-M_2 as long, or nearly so, as the black oblong just proximad of it .... *P. d. hazelea*
   Transparent submarginal spot in M_1-M_2 of fore wing less than one third the size of the black oblong just proximad of it .... *P. d. dercyllidas*
3. Translucent areas with a greenish hue; nearly all the costal margin of the under side of the hind wing greenish white .... (*P. demylus*) 4
   Translucent areas with a blue-white hue; a series of translucent white submarginal spots present at the distal ends of the cells against the opaque border; hind wing with only the humeral angle and the proximal one third of the costal margin anterior of Sc greenish white .... *P. oligyrtis*
4. Dark cross bands in R-M_1 and M_1-M_2 of the fore wing and the dark postmedian band of the hind wing decidedly narrower than the marginal color nearest each .... *P. d. gemellus* new subspecies
   Dark cross bands R-M_1 and R_1-M_2 of the fore wing and the dark postmedian band of the hind wing decidedly narrower than the marginal color nearest each .... *P. d. demylus*

The locality records of the series in the British Museum (Natural History) are of interest:

P. d. dercyllidas. Venezuela: Merida (1 ♂, 1 ♀). Colombia: Manizales (1 ♂, 1 ♀); Bogota (holotype ♀); Rio Meta (1 ♂); Rio Chile (1 ♀); "interior" (1 ♂). Ecuador: Chimba (1 ♂); environs of Ambato (2 ♂, 4 ♀).

P. d. hazelea. Ecuador: Sarayacu (1 ♂, 1 ♀); Banos (2 ♂, 1 ♀); environs of Ambato (6 ♂, 6 ♀).

P. demylus demylus. Ecuador: Zamora (1 ♂); Sarayacu (holotype ♂, allotype ♀); Loja (2 ♂); general (3 ♂, including holotype of *hewitsonii,* 2 ♀). Peru: Chanchapoyes (1 ♂, 3 ♀); "northern" (2 ♂).

P. demylus gemellus. Bolivia: Taunas (holotype ♂); Farinas (paratype ♂).

P. oligyrtis. Ecuador: Sarayacu (1 ♀); general (3 ♀ including holotype).

Genus *Tithorea* Doubleday

Bryk (1953) presented a bulky list of neotropic butterflies in which he described some thirty-one new Ithomines. One of them is *Tithorea pinthias melini* (Bryk *op. cit.,* 25). The authorities at the Swedish Museum of Natural History, Stockholm, very kindly lent me Bryk's type specimens for study. *Tithorea pinthias melini* is an absolute synonym for *Tithorea tarricina bonita* Haensch.

Zikan (1940–1942) described twenty-five Ithomines, all from Brazil. Ferreira d'Almeida (1956) discussed these names, having the Zikan collection available in the Brazilian Museu Nacional, and figured many of them. Two are *Tithorea. Hirsutis harmonia sulphurata* Zikan (*op. cit.,* p. 15) is from Sao Gabriel and Cucui, Rio Negro, in the Amazon valley. d'Almeida (1956) believed it to be an aberration of *T. h. harmonia,* which conclusion agrees with expectancy based upon distribution. The name falls as a synonym, therefore.

Tithorea harmonia caissara (Zikan)

Hirsutis caissara Zikan, 1941, p. 14, fig. 10; Espirito Santo and Itatiaia.

Tithorea caissara d'Almeida, 1956, p. 2, fig. 1.

d'Almeida illustrated a male from Serra da Cantareira, Sao

Paulo. Both this and the type locality are well eastward of any record I have seen for *T. h. pseudethra* and well southward of the Amazon valley fauna. Evidently *caissara* is the subspecies inhabiting southeastern Brazil. In my key (1956, pp. 47–49), *caissara* runs to couplet 19 with *cuparina* and *harmonia*. This couplet should be modified to read as follows:

19. Apical spots of fore wing minute, the yellow spot in the anal angle isolated; the yellow streak over Cu_1 pointed, not strongly T-shaped .... *T. h. cuparina*
   Apical spots of fore wing small; the yellow spot in the anal angle isolated; the yellow streak over Cu_1 strongly T-shaped *T. h. caissara*
   Apical spots of fore wing larger, narrowly separted from each other by black veins; the yellow spot in the apical angle not usually isolated; the yellow streak over Cu_1 T-shaped........ *T. h. harmonia*

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THE CORRESPONDENCE BETWEEN WILLIAM HENRY EDWARDS AND SPENCER FULLERTON BAIRD

PART IV

1867–1868

ANNOTATED BY F. MARTIN BROWN[1]

Sometime during October, or probably November, 1866 Edwards' fifth paper describing new species was published. This was "Descriptions of certain species of DIURNAL LEPIDOPTERA from within the limits of the United States and British America. No. 5". It appeared in the October, 1866, issue of the Proceedings of the Entomological Society of Philadelphia on pages 200 through 208. In it he described as new eight species and at the very end listed thirteen species he had received from Arizona. This material from Arizona had reached Edwards through Baird and had been collected by naturalists attached to Army units in the state. The source can be traced in the Annual Report for 1866, p. 46, where, among others assigned to Edwards for study, are noted "Lepidoptera collected . . . by Drs Coues & Palmer in Arizona." Palmer was the entomological collector of this team. The collections were made in the vicinity of Fort Whipple, near Prescott. [For Elliot Coues, (1842–1899) see Hume, 1942, pp. 52–89; for Edward Palmer, (1821–1911) see Popular Science Monthly, 78; 341–354, 1911.]

8878
[Rcd Dec 4 1866]
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Newburgh, N. Y.
2 Dec 1866

Prof. Baird
Washn.

Dear Sir

I reached home from West Va. last eveg. I found the box from Sumi-

[1] With the agreement of Mr. F. Martin Brown, the editor assumes responsibility for the modification of Mr. Brown's article. Certain letters have been omitted, others have been extensively edited. A considerable portion of Mr. Brown's annotation has also been deleted. The *Journal* has now published all parts of this article submitted before 1960.—W.S.C.

chrast here, and have just gone over its contents. It is not worth while for him to send me any more insects so miserably put up, and of such common species. I enclose / one of the Sphinges as a sample of the whole (20 or so in all.) Not a decent one among them. There were about 80 butterflies, nearly all yellow ones, which are the commonest of the order. Some of the butterflies are in good order. But not one of the Sphinges. Mr. S. ought to know how to protect his collections by camphor or similar means. But he uses nothing. I had offered a large price for good Sphinges & several of us counted on getting a valuable set from him this season. It would be better for the Sphinges to be pinned & spread, if he could also guard the bodies by pins from danger of being shaken off. The butterflies may do well in papers. I will do what I can with these things. But I want no more unless he can send in good / condition.

I sent you the money for the first lot just as I went West, in Oct.

I have a letter from Bernard Ross, at Rupert Fort,[131] saying that if I will send you nets etc he will collect for me next year. Also that he has some now which he will send to me through you. What books can I send to Mrs. Ross that would be of interest to her?

Yours truly
W. H. Edwards

8925?
[Rcd. Dec. 11, 1866]

Newburgh, New York
10 Dec. 1866

Prof. S. F. Baird
Washn.

Dear Sir.

Your two letters of 4th & 6th are duly recd. I return the German letter. I do not know any one who wishes European butterflies.

I will send a box to you for Ross in a few days, so soon as I can get together the articles for him.

I find the greatest difficulty in getting the / figures drawn of my butterflies (on stone). I have had four plates made, but 2 are imperfect and will have to be done over again. The artists do not understand *drawing for coloring*, which is quite different from drawing where no color is to be applied. I have found a good colorist in Mrs. H. P. Gray, wife of the artist,[132] in New York. Except for the difficulty named, I should have issued No. 1, 5 plates of the Argynnides before this.[133] I have half a mind to send the insects to Robinson[134] of London, the B [ritish] Mu-/ seum

[131] Rupert House is on the east shore of Rupert Bay on the south side of the mouth of Rupert River, 51° 29′ N. Lat., 78° 46′ W. Long. in the province of Quebec. It has long been a headquarters for the Hudsons Bay Company in the Hudsons Bay region.

[132] Henry Peters Gray (1819–1877): (National Academy 1842, president 1869)

[133] The first fascicle ultimately was issued in June 1868.

[134] Edward William Robinson (1835–1877): steel-engraver and artist,

artist. He works for 5 shillings per figure, & does his work well.

Yours truly
W. H. Edwards

12163 ? 418

Washington Dec. 11, 1866

My Dear Mr Edwards,

I have yours with samples of plates. I wish you could find the right man to draw. Why not try Richards, our former artist. He would do the work much better and is one of the best colorists in the country. His address is J. H. Richards, Fall of Schuylkill, Phila.

Yours truly
Spencer F. Baird

W. H. Edwards
Newburgh.

89—
[Rcd Dec 14, 1866]
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Newburgh, New York
Dec. 14, 1866

Prof. Baird.

Dear Sir.

I will communicate with the artist at Schuylkill. Much obliged to you.

Will you give me an opinion upon the following case, from the usual proceedure among ornithologists & Mammalogists.

Perhaps you recollect Lycaena Comyntas, a small purplish butterfly abounding in the north. It expands 1 in. Wherever we find that we find a minute species, expandg 7/10 inch (the smallest Lycaena known) marked precisely like it, & of same color. Dr. Harris[135] had a mind to call the little one a species. The other day I met J. P. Giraud[136] on the cars, & talking / over various matters with him I spoke of this case. He said that Ornithologists would of course, make the smaller a distinct species, & mentioned "the lesser Tern", and "the lesser Marmot" in Mammalia.

What say you? If you say make a distinct species, give me one or two examples among Birds so that when I describe it I may refer intelligently to them.

Do you know whether the common field mouse makes any noise? I have

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often employed by the British Museum (N. H.). Obituary in *Ent. Mo. Mag.* 14: 118–119. 1877.

[135] Edwards Doubleday Harris (1839–1919), an entomological enthusiast living in the New York area. (See Carpenter, 1945, pp. 42–43.)

[136] Jacob P———. Giraud (–   ): A New Yorker who had collected birds in Texas in 1838. He was an early (1844) member of the Lyceum of Natural History of New York, the forerunner of the American Museum of Natural History.

a singing mouse in a cage, caught in a trap in my bed room. It makes a noise, sometimes like a cricket (somewhat) & sometimes like bubbling of water. Have had him two months, when he sings his throat moves like a bird's. He has a / more pointed nose than a house mouse, & is lightest on the belly. I have in mind to send it to you alive. Before I caught it, it would keep me awake for an hour together by its stridulous noise. In the cage he may sing occasionally. But when he is able to get out of the cage & run about the room, he sings all the time.

Yours truly
W. H. Edwards.

12235 444

Wash. Dec. 15, 1866

My Dear Mr. Edwards,

I would not call the small *Lycaena* a new species. I would call it *var.* "nana" or something of that kind so that if the specific value should at any time be established this var. name might be taken up. If absolutely similar except for size it would be rather difficult to establish a species.

Perhaps your mouse is a Dear Mouse or White-footed Mouse. The field mice proper all have very blunt noses.

Sincerely yours
S. F. Baird

W. H. Edwards
Newburgh.

9000
285
Prof. S. F. Baird

Newburgh, New York
22 Dec 1866

Smithsonian Ins.
Washn. D. C.

Dear Sir

I send today by express a package addressed "Smithsonian Ins." Under the outer wrapper, it is addressed "Bernard R. Ross" etc. It contains cork, pins, rings & netting & poison, & some of my published plates. The direction on the package is from his own letter. I should infer from his letter to me of 12 Aug. that he wd collect a little this summer, & send me the results thru' you.

I fear I have lost the mouse. He got out of the cage and has sung no more that I have heard.

Truly yours
W. H. Edwards

[Rcd Feb. 7, 1867]
212

Newburgh, New York
5 Feby, 1867

Prof. Baird
Smithsonian
Washn.

Dear Sir.

I wrote Francis Walker to learn what the artist of the B. [ritish] Museum

wd draw on stone my Argynnides for. He replies for 70 or 100[137] per figure & will furnish one colored copy. He does his work well, as we know by 3 plates of our sphinges. The only doubt I have is any to his damaging my specimens. I should be sorry to / send those fine things over there & have them come back ruined. If I have him draw the figures, I will have a certain no. struck off there, say 250 to 500, as I dare venture.

Yours truly
W. H. Edwards

Do you get no butterflies from the far West now-a-day?

[Rcd May 7, 1867]
213

Coalburgh, Kanawha Co.
West Virginia
3rd May, 1867

Prof. S. F. Baird
Smithsonian
Washington.

Dear Sir

I should have sent you Ten Dollars which I received for Sumichrast's insects last winter, before I left New York. But it escaped me and I now enclose same. The insects were in miserable condition and, as I thought, worth nothing, but I sold the lot for Ten Dollars.

I have been kept out here longer than usual and am likely to remain most of the season. Have already taken a great many butterflies the last month.

If there is any chance to secure me any butterflies from Russian America[138] or the Rocky Mtns. dont forget me.

I expect through you the insects promised by Ross this season.

Yours truly
W. H. Edwards

I have lately had a handsome plate of Argynnis Diana ♂ ♀, four figures on one plate, by Weist [sic][139] of Phila.

But this is the / last he can make this year he says.

[137] The artist in question is Robinson (see note 134). The price quoted is in cents (gold) and more reasonable than Edwards was able to find in this country.

[138] See note 113. The American group was operating in Russian America under the scientific leadership of Robert Kennicott. Upon his death the leadership was transfered to William Healey Dall (1845–1927) (DAB 5: 35–36, 1930). The materials collected were shipped to the Smithsonian as a depository. Ownership was retained in them by the Expedition and the final disposition up to Kennicott. Most of the material collected went to Chicago and was destroyed by fire.

[139] D.— Wiest: lithographer, living in the Philadelphis area who took over the task of preparing the stones for Edwards' plates. He was succeeded by an anonymous artist working for Cassin in the Bowen plant.

13667

Washington, May 7, 67

Dear Mr. Edwards

I have yours with 10.00 for Summichrast [sic].

We have a very large collection of handsome butterflies from Bogota just brought by our late Minister. At least a pack of papers enclosing specimens and apparently in good condition. We are to have a series ourselves and distribute a few sets: the rest to be returned named. Do you want to take and name, for a series ? and when.

Yours truly
S. F. Baird

W. H. Edwards
Coalburgh, Kanawha Co.
Va.

[Rcd. June 3 1867]

Phila. Sundy. 2 June 67

Prof. Baird
Smithsonian
Dear Sir.

I found I could not go on to Washington without losing tomorrow as well as today, and I have not the time, which I regret much. My family have just returned from St. Augustine from 3 months absence, & are waiting impatiently my arrival in New York. If possible I will come & see you yet before I go back to Kanawha, 1 July. You may send the butterflies to me at 40 Wall & I will have / them duly attended to & returned according to instructions.

I learn here that an expedition is started for the far West, in which the Smithsonian are [sic] interested.[140] I hope you will reserve me some of the Butterflies from that source.

I find that the artist, who drew my 3 plates of Argynnis, is willing to go ahead, and I will therefore have 2 more drawn and issue as soon thereafter as / I can get the first number of 5 plates of the work. Hope I can accomplish it this year, and initiate a creditable work.

My address will be 40 Wall, N. Y. I dont know that I will be at Newburgh this season.

Yours truly
W. H. Edwards

Most of the plates prepared by Wiest were later redrawn by Mrs. Mary Pert. The only ones remaining in the final edition of the first part of Edwards' Butterflies of North America are those for *Argynnis cybele* and *Argynnis aphrodite*. Only the plate of *Argynnis atlantis* survived of those done by Cassin's man. The plate of *Argynnis diana* noted here was withdrawn after publication and replaced by one done by Mrs. Pert. An earlier plate of *diana* is noted in footnote 108.

[140] This was Clarence King's expedition to make a geological survey along the 40th parallel. The naturalist for the party was Robert Ridgeway.

14077 281

Washington, June 3 1867

My Dear Mr Edwards,

The butterflies went yesterday. They were collected by Hon. A. A. Burton, U. S. Minister to Colombia, principally about Bogota. Some from the Magdalena River.

The specimens are Mr. Burton's. He however gives us a series (which please keep for us) and wants a private series selected and named for himself. If series can be supplied with advantage to any public Museums, especially Chicago, he wishes to do so. Any residuum after / these selections he wishes to use as presents to personal friends.

Of course you will have a series for your labor. Mr. Burton might be friendly, I suppose, to suggestion that you will select a series for us to send Mr. Osbert Salvin.

As for selections, I suppose the great bulk will consist of a few species. Where I had .... each in a separate box each paper numbered. Number to correspond to names of them on a list.

I will do what I can to get what you want of NW specimens.

Truly yours
S. F. Baird

W. H. Edwards
40 Wall St.
N. Y.

10344
[Rcd. June 12, 1867]

Newburgh, New York
10 June 67

Prof. Baird
Smithsonian
Washington
Dear Sir.

The contents of the package astonished me. On opening the tin box and looking over the papers, I should say there were nearly a bushel of same, and at least 2000 to 3000 specimens. I wish I had time to attend to the naming & distribution of them, but, with my press of business, it is impossible. I did not imagine the undertaking to be of such magnitude. So far as I opened the papers the specimens are good ones, and well put up. I saw no sign of dermestes. There are evidently many duplicates.

The only man who can name these things is Mr. Reakirt[141] of Phila. if he has the time to apply to it. If it is agreeable to you I will send them to him with your instructions. I will wait to hear from you in reply / before doing anything about it.

[141] Tryon Reakirt (–): merchant and avocational entomologist, who was living in Philadelphia at the time of this letter and later in Wilmington, Delaware. Some time before 1878, Ferdinand Heinrich Herman Strecker (1836–1901) purchased Reakirt's butterflies. They now are with the Strecker Collection at the Chicago Museum of Natural History.

I have Glover's[142] plates, just sent by him & am much pleased with them. If he lives long enough to make a tolerably complete collection of figures, it will be very valuable & immortalize him.

Yours truly
W. H. Edwards

14165 343

Washington, June 12, 1867

Dear Mr. Edwards

It will be perfectly agreeable to us to have Mr. Reakirt name the 'flies. Find whether he would like to do so and we will write him. How about Grote and Robinson of N. Y.

Yours truly
S. F. Baird

W. H. Edwards
N. York

10478
[Rcd. June 22, 1867]
217

Newburgh, New York
19 June 1867

Prof. Baird
Washn.
Dear Sir.

I enclose Mr. Reakirt's letter & I will forward the butterflies to him today. You can write him directions. His address is 355 North 3rd St. Phila.

You inquired in your last about Grote & Robinson,[143] that is as to their knowledge in naming butterflies. Mr. Grote is the active & Robinson the moneyed partner I believe. Mr. G. must be well acquainted with our moths. Quite lately he has turned his attention to / Diurnals, and they have been buying specimens from all countries. But it is not possible that they could have yet attained much knowledge of the Diurnals.

[142] Townsend Glover (1812–1883): entomologist, the first man employed as entomologist by the U. S. Department of Agriculture retiring in 1878. (see DAB 7:333–334.) The plates alluded to here were the first of those issued for what was to be an iconography of American insects. They were printed from copper engravings made by Glover. The work was never completed nor was it published although sets of the plates may be found in a few libraries. In 1877 some of the original plates acted as the drawings upon which were based the lithographic illustrations in Glover's "Manuscript Notes from my Journal or Entomological Index to names, etc, in Agricultural Reports . . . ." Transfered to and printed from stone by F. C. Entwisle, Washington, D. C., of which only fifty copies were prepared.

[143] Coleman Townsend Robinson (1838–1872): stockbroker in New York, who with Grote published numerous papers about lepidoptera, mostly moths. Robinson himself published several papers, mostly devoted to microlepidoptera. (See Carpenter, 1945, p. 86).

Reakirt has a Miscellaneous Collection altogether of Diurnals, & knows more of them than any one we have, that is, foreign species—for I wont allow that any one knows more of U. S. species than myself.

Yours truly
W. H. Edwards

[Rcd. Oct. 15, 1867]
[Rcd. Oct. 20, 1867]
219

Phila. 13th Oct. 1867

Prof. Baird
Dear Sir.

I am sorry I had not the pleasure of seeing you in New York, but I was in town only during business hours & for two days. I am on my way to Kanawha. I mean to make arrangements for living there with my family after this winter.

I find that I can go ahead with two plates of the Argynnides during this winter. The first 5 will then be complete & I shall take measures to issue the first number as / soon thereafter as I can have the letter press attended to.

I saw Reakirt yesterday. He is working at the Bogota butterflies. Finds several new species, one of which is a large and handsome Papilio.

Yours truly
W. H. Edwards

$\frac{11435}{1}$ and 37495
[Rcd. Dec 14, 1867]
221

Newburgh, N. Y.,
12 Dec. 1867

Prof. Baird.
Washn. D. C.
Dear Sir.

Yours of the 8th was duly recd., and yesterday I got the box from Akhurst. The insects from Sumichrast are in better order than usual. There were 5 or 6 Sphinges and for once they were not eaten up. I will sell the butterflies – 3 or 40 [sic] – & send you for him the proceeds of the whole. There was another box labelled from Monterey—I suppose from Cala—The contents were broken and worthless any how—except one ♀ Colias,[144] which singularly enough was the only unbroken specn. What it is I don't yet know, but it looks like a new species. The rest were common—such as Danais Archippus, Melitaea Chalcedon, etc.

[144] There are two possibilities for this: It may have been what Edwards described as *ariadne* in the *Transactions of the American Entomological Society,* vol. 3, p. 12, 1870; or, it may have been a much more distinctive insect that was named *Colias harfordi* by Henry Edwards in 1877 in the Proceedings of the *California Academy of Natural Sciences,* p. 9. I can find no evidence that Edwards ever used this specimen as the type for a new name.

I dont want the Guatemala butterflies, but perhaps Reakirt will & as I am writing him today will mention the matter.

I expect to sell my place here very shortly & after this to make my head quarters at Coalburgh, Kanawha Co. W. Va. Articles for me will be sent by express to Cinc. & I will give you my address in due time. I shall be here till 25th inst. at any rate.

I believe I have 5 plates[145] of the Argynnides now drawn ready for coloring, and I have nearly prepared the text to accompany them. I propose to put out a number with 5 plates. The size will be that of Hewitson's Exotics, or say Kirby, books which you have. If I can get Weist [*sic*] to proceed with drawing I will put in his hands 5 more. At first I thought I would publish only the Argynnides but as there are several new large species of other genera—Limenites, etc, etc,—I intend to publish any thing and let the numbers run along as I have time till I make a volume. Now what shall I call it, "Illustrations of the Butterflies of U. S. & B. Ama." or what? And shall I say anything of the habits, / localities where I am able from personal observation, or confine myself strictly to descn.?

And where 2 sp. have been generally confused, shall I explain at length & rectify the matter, or would this properly come into such a publication as the Phila. Transactions Ent. Soc. & not into such a work as I propose? Give me the benefit of your experience.

I see that I have named more than 70 species[146] U. S. & B. Ama. butterflies & in all probability 150 sps. / have been described since the rush to Califa. in 1849, none of which are anywhere figd. except in the small publications of the Ent. Soc. Phila., & two or three in New York.

I mean to go to the end of the Pacific RR., Colorado, next summer, & from thence will bring back plenty of material.[147]

Yours truly
W. H. Edwards

15379 433 & 434

Washington, Dec. 15, 67

My Dear Mr Edwards

I have your letter of 12. and hasten to answer. I was glad to learn that Sumichrast's collection "panned out" better than usual. The Monterey was California, collector, Dr. C. A. Canfield, who should be credited in description.

By all means save for us all good fossils you can raise: we want them very much.

I would publish all the species of butterflies refered to, adding a part time after time as new material comes in. The whole ought to form a good volume.

[145] The five plates figured these species: I *diana,* II *cybele,* III *aphrodite,* IV *nokomis* and V *atlantis.*

[146] By actual count Edwards had described 71 species by December 1867.

[147] Edwards did not make this trip. His only trip into Colorado was made in 1894 when he and David Bruce stayed at Glenowwod Springs, Garfield County. In 1867 "head of rail" was Denver.

As to title:[148] I would say "North America" instead of U. S., British America. One day it will be all United States, and United States will be North America. The Smithsonian version of North America means north of Mexico. "Middle America" is from north line Mexico to Atrato River.[149] Lower California is North America.

LEPIDOPTERA
of
NORTH AMERICA
ILLUSTRATED
By W. H. Edwards
Figures (or Illustrations)
of
North American Lepidoptera

ILLUSTRATIONS
of
LEPIDOPTERA (or Butterflies)
of
NORTH AMERICA

It will make an awkward title to have region take too much space./

I would add all I know as to localities, habits, etc. You will even then hardly have enough text to balance the plates and make a good volume. No more appropriate place. I would also give list of all described N. Am. species of the different genera figured and even Synopsis. All these points add greatly to the value of such works and increase the demand. Make the whole as complete as you can.

You should by all means have a publisher whose imprint may be affixed: as B. Westermanns, & Co. or somebody else: perhaps Hurd & Houghton.[150]

Yours truly
S. F. Baird

W. H. Edwards
Newburgh
N. Y.

[148] The title settled upon by Edwards "*The Butterflies of NORTH AMERICA*" seems to have been based upon Baird's third suggestion. In the original letter the words I have capitalized are written in upper and lower case but marked for full capitals.

[149] This division of the Americas into three regions is in essence that accepted today. Biologically North America extends southward and takes in most of Mexico, Middle America now is considered to find its southern boundary in Darien, south of the Panama Canal Zone but not so far south as the Rio Atrato in Colombia.

[150] The second and third volumes and the reprinted text of the first volume of *The Butterflies of North America* were published by Houghton, Mifflin and Company of New York, New York, the work being done at The Riverside Press of Cambridge, Massachusetts. Hurd & Houghton was the forerunner of Houghton, Mifflin & Co.

11582
144

Jan. 11, 1868

Prof. Baird
Washn.
Dear Sir.

I go West next Wedy. & shall be at Coalburgh, Kanawha Co., W. Va. My express direction will be "Care of J. D. Hunt
36 Walnut St.
Cincinnati."

When Ross's insects come send them on.

I have made full / arrangements for the issue of No. 1 of the "Butterflies of N. Ama." about 1st Apl. & No. 2 3 or 4 months later.[151]

Instead of giving it to a publishing house I propose to issue it from the Ent. Soc. of Phila.[152] & have the printing done on the premises. Cassin advises me to do so, and it saves me a vast deal of trouble as I can have Cresson attend to printing & all / other matters pertaining to the issue.

Grote reports—after a visit to the Ent. Collections of London, Paris, Vienna, Berlin, etc, etc, [–] that our species are not known much, & all Amn. Collections in very bad order. Moreover naturalists there in ignorance of what we are doing all working on same species.

Yours truly
W. H. Edwards

The following undated draft by Baird for a letter to Edwards to be signed by Prof. Henry, the Secretary of the Smithsonian Institution, seems best placed here. There is an hiatus in Baird's letters at this point.

678

Sir,

We beg to enclose herewith sundry Lepidoptera collected by Mr. Robert Ridgeway under command of Mr. Clarence King with the request that you will add them to the others in your charge belonging to this Institution. You are at liberty to describe any new species under the usual conditions of mentioning them as derived and belonging to the Smiths.

[151] The first fasicle was issued in June 1868, on or before the 5th of the month.

[152] At the meeting of February 25, 1861, the members of the Philadelphia society accepted the proposal of one of the organizational members, John Meichel, that, if the Society acquired a hand press and type, he would attend to the composition and presswork. Whether or not Meichel was responsible for setting and printing Edwards' first volume I have been unable to learn.

We are about sending to Mr. Reakirt for examination and report a small collection of Lepidoptera of Yucatan.
W. H. Edwards
Coalburgh
Kanawha Co.
Va.

38702
140
Prof. S. F. Baird
Smithsonian, Washn.
Dear Sir.
I recd today a letter from Prof. Henry of 31 Jan. saying that a lot of butterflies had been forwarded. Your hand seems to have addressed a note that they were sent with others from Sumichrast. I hope they were sent to J. D. Hunt, 36 Walnut St., Cinc. (See on this paper above). If so shall soon get them. They were "Collected by Clarence King". Who is he and where are they from?[153]

Yours truly
W. H. Edwards

I have a few dollars for Sumichrast proceeds of last small lot. I sold the butterflies for 10 c gold cash, amt to $3.60 & will pay for the Sphinges that I kept myself.

11920
[Rcd. March 4, 1868]
138

[Coalburgh, W. Va.] 25 Feby, 1868

Prof. Baird, Smithsonian Ins.
Washn.
Dear Sir.
The butterflies from Somichrast [sic] came today from Cinc. They are the best lot I have ever seen from him. There were 8 or 10 only eaten by insects, and throwing them out, there are 158 specimens for which I will duly send you 10 cents ea. in gold. When you write him, tell him to send all of the species of *Thecla* he can find. And tell him to make an effort to collect Sphinges again this season, & when collected to get them here in good condition. If he will use *creosote* or other powerful odor, I think he will save them. He had better put them in paper (although I once sent him word not to) as they break less than when he pins them, and probably are more easily protected against insects.

As to the insects from Califa, which I had expected to be something fine from Prof. Henry's official notice of them and charge to take care of them, they are worthless, all common species & all eaten by insects. I enclose one that you may see & the rest I shall burn up.

You advised me to publish a Synopsis of N. An. species in my Butter-

[153] Apparently Henry modified the draft letter written by Baird. From Baird's draft we know that the material was collected by Ridgeway.

flies.[154] I can commence this in the 2nd or 3rd number. Should I adopt all of the new genera of Tom, Dick & Harry, or have I discretion to do as I think best about that? Somebody has cut up *Argynnis* and made a new genus *Brenthis* of part of it. Now Argynnis was not a crowded genus, and the difference between Brenthis and the rest of the genus, is not greater than between what Boisduval calls groups. For instance, there are many groups of Papilio, whom no one yet ventures to subdivide, but which could as properly be as Argynnis. I detest this genus making, in the spirit in which it is ground out.

Yours truly
W. H. Edwards

3907..
[Rcd. March 16, 1868]
139

Coalburgh, Kanawha Co.
W. Va. 11 Mar 68

Prof. Baird
Smithsonian Ins.
Washington
Dear Sir.

Yours of 4th just comes to hand. Of course I want you to send me every butterfly, good and bad, that comes along. I usually have not recd letters from Prof. Henry, in form, in the receipt of an invoice, but have once or twice, as on this late occasion, and it gave me the impression that he thought I had heretofore recd & was now receiving insects of value for which I might be called to account some day. I wished to show you in time what sort / of an invoice the present one was. All right, let me have good and bad.

I enclose (or direct our bank at Charleston to) for Sumichrast a draft for $30.88 with account, & a letter telling what I want.

I am glad you counsel me to use my judgment about admitting new Genera. There is a fashion among German Lepidopterists of magnifying Hubner who made as many genera as species, and as Boisduval shows in the Intro. to Spec. Genl, page 184, in a most ridiculous manner. Some of our writers affect to follow Hubner & the Germans and I dispise the lead.

Yours truly
W. H. Edwards

39864
[Rcd. May 12, 1869]
135

Coalburgh, Kanawha Co.
West. Va.
4 May 68

Prof. S. F. Baird
Washn.
Dear Sir.

I send you a proof of the first sheet of Part 1 of the Butterflies of. N. A.

[154] This was done and the Synopsis constitutes an addendum to Volume I of *"Butterflies of North America"*.

& hope you will be pleased with its appearance.[155] Cassin is doing his best with the plates, & the number will be ready for delivery in a fortnight. I suppose we may reckon the Smithsonian as a subscriber. You will have it in your power to show the work occasionally to gentlemen who desire to encourage the *fine arts.* I / will tell Cresson to send you Part I for yourself. Note the woodcut of a fossil butterfly similar to Diana.[156]

I wish we might hear from Ross. If you write him this year, urge him to do what he can for us. I will have all my numbers sent to him as they appear. I rely on him for several new species.

Yours truly
W. H. Edwards

The following draft by Baird, without date, apparently was prepared for Henry's signature:

17406

We have much pleasure in sending you by mail for inspection a small collection of Lepidoptera just received from Dr. G. Lincecum, Washington Co., Texas[157]

W. H. Edwards
Coalburgh, Kanawha Co.
West Virginia

. . . .369
12374

[Coalburgh, W. Va.]
June 5 1868

Prof. Baird
Smithsonian, Washn.
Dear Sir.

I have received from the Smithsonian a package of insects from Texas and a letter from Prof. Henry mentioning sending same.

I have your letter of 20th May, came in my absence to Cinc. Part I of butterflies is issued.[158] I wrote Cresson to send you a copy with my compli-

[155] The first signature of four pages was devoted to *Argynnis diana.*

[156] This is *Vanessa pluto* Heer from the Miocene beds of Croatia.

[157] The title "Doctor" was acquired by Gideon Lincecum (1793–1874) through his unaided study of medicine. His formal schooling was no more than five months in a backwoods Georgia school. He did not serve the usual apprenticeship with a recognized medical man but "read medicine" with no preceptor. From 1848 to 1867 he lived near Long Point, Texas. Later he migrated to Tuxpan, Vera Cruz, Mexico, where he lived the rest of his life. An autobiography of Lincecum was published in 1904 in Volume 8 of the *Mississippi Historical Society Publications.*

[158] This letter places the date of issue for Part I between the 1st and 5th of June 1868. The species figured are *Argynnis diana, cybele, aphrodite, nokomis* and *atlantis.*

ments & an other for the Smithsonian to subscribe for. The number actually cost more than the price charged, viz $2. The coloring alone was 1.50. Science has hard times has she not? I can't find the letter from you mentioning names of one or more magazines in Europe I think to which you advised sending. Please write Cresson / about that, & he will send then as you suggest.

He has the prospectuses ready for you & probably has sent them.

There was nothing valuable in Lincecum's collection. Half was made up of our common Papilios & Danais Archippus. There are a lot of moths which I will return to you as some other collecter may like them.

Yours truly
W. H. Edwards

17205

June 13, 1868

Dear Mr. Edwards

I have yours of Inst. The copy of "Butterflies" came all right for which I much obliged. The bundle for distribution[159] also has. We will forward duly as desired and send list hereafter. The prospectuses are all here and will be attended to.

We are arranging with Sumichrast to go to Western Mexico for a year or two: I suppose you will take a series of his butterflies.

Sincerely yours
S. F. Baird

W. H. Edwards
Coalburgh

40853
[Rcd July 21, 1868]
132

New York, 40 Wall St.
20 July 68

Prof. Baird
Smithsonian Ins.
Washington
Dear Sir.

I reached this city on Saturday from Kanawha, & at Cinc on my way I found the box of insects, part of them from Sumichrast. I will see them duly sold & remit you proceeds. If he goes to the West Coast he might get some valuables. I will take one set, & I can dispose of probably all he will send, if sent at first to me. I usually examine the packages for Califa or U. S. insects,[160] which are all I care for.

[159] The bundle contained 10 copies of Part I to be strategically distributed in Europe. The prospectuses were more widely dispersed by Baird.

[160] Like many modern collectors of "North American" butterflies, Edwards was quite willing to include in his collection Mexican specimens of species that occur or stray north of the border but unwilling to build a collection of

I wish I could get in- / sects from New Mexico or Arizona. There are hundreds of undescribed butterflies I am confident in that section. If I can raise the money next year I believe I will send a collector on my own account. But you may do something for me.

My book is taking well I believe, & appears to be appreciated. Cassin thinks we will get a circulation of 500 before we get to the end of the 1st volume.

Subscribers come in from the most out of the way places, in Minnesota, Ky., Missouri etc etc. Several go to Canada.

Yours truly
W. H. Edwards

41901

[Coalburgh, W. Va.] 9 Sept. 1868

Prof Baird Smithsonian
Washington

Dear Sir

I venture to write though I doubt if you have retd from the North. I shall have some money for Sumichrast to send you when I hear of your return. My last letter from Bernard Ross was dated Rupert House 12 Aug 1866, & he therein says he will send me a package of insects in the first box he send to the Smithsonian, & expressed a wish for pins, etc. I sent on nets, pins, etc through you & he ought to have recd them in June 1867. Do you know anything of him later than the letter he wrote me. I am exceedingly anxious to get the butterflies of that region, as there should be several new & rare species from there. I would send / Parts 1 & 2 of the Butterflies to him by mail if they wd go that way. But I doubt they would. What do you think of it. Otherwise they would have to go via London, per packages.[161]

Yours truly
W. H. Edwards

Although the cover for part 2 of Butterflies of North America is dated August 1868 Edwards stated in the appendix to Volume I that it was issued in October of that year. It contained the plates and text for *Argynnis callippe, Argynnis hesperis, Colias alexandra, Colias chippewa* (as *helena*), *Colias behrii, Colias Christina* and *Apatura alicia.*

Mexican material. It is interesting to see that Edwards, after twenty years, was still thinking of California as outside of the United States.

[161] Rupert House had two routes of contact with the outside world at this time. Letters could be carried over the canoe route via streams and lakes to Moose Factory on James Bay and from there across the bay to Rupert House by cutter. Any bulky shipment had to go to London and then by the yearly supply ship to Hudsons Bay where the ship visited the posts to drop supplies and pick up furs.

42061
[Rcd Nov 16 1868]
62 Coalburgh, West Va., 10 Nov. 68

Prof. Baird
Smithsonian
Washn

Dear Sir.

Yours of 3rd came this morning, with Texas butterflies enclosed. I keep a few and return the rest as you request. Why cannot Lincecum put up good specimens as easily as poor ones. Of a lot sent last summer (or spring) there was scarcely a decent one, because all were worn out before they were caught. Perhaps he sells the good ones and sends you the refuse.

The balce due Sumichrast is $15.37 for 116 specimens with gold at 132½.[162] I shall be in Charleston within a week & will send you draft for same. /

We never have heard from the copies of Part 1, Butterflies sent to Europe thru' you. If you see any friendly notices of them let us know.

I wish to write Bernard Ross & to send the parts as published. Had I better send then to you, to go to London. If they cannot leave London before next Spring, there will be 4 parts ready.

Is his post address as it was last year, Rupert House, care H. Bay Co., Fort William, Ottawa River?[163]

I am troubled about the expense I am put to to get my drawings made and colored. Cassin charges $30 per plate for the drawing, and 30 cents per sheet for coloring (including paper & printing). That makes an edition of 150 copies cost $375. for those items only & nothing to say about paper, printing, electrotyping & binding. For the whole edition I get $300. & then booksellers sell copies 10 or 20 per c off that. That is rather severe and I shall have to find other artists. Do you know any who will undertake the work & do as well at less charge to me. The drawing shd be but $15 per plate & coloring not over 20 c.

Yours truly
W. H. Edwards

The November issue of the *Transactions of the American Entomological Society* (2: 207–210, 1868) carried Edwards article "Notes on a remarkable variety of PAPILIO TURNUS, and descriptions of two species of DIURNAL LEPIDOPTERA." The *turnus* was a female, one side of which was the dark form

[162] The rate of "exchange" between the gold dollar and the "greenback" dollar, i.e. at this time one gold dollar was worth 1.32½ "greenback" dollars.

[163] A letter from Mr. Clifford P. Wilson, editor of *"The Beaver,"* house organ of the Hudson's Bay Company states: "The address you have for him [Ross] at Rupert's House, refers to Fort William on the Ottawa not at the head of Lake Superior. The route would be up the Ottawa, across to the Abitibi and so down to Moose Factory and across to Rupert's House."

glaucus, the other the black and yellow form *turnus.* It was received by Edwards on the first of September 1868 "from a young friend in this neighborhood [Coalburgh, West Virginia]."

Late in 1868 (November or December) there appeared the first issue of a new journal devoted to entomology, "*The Canadian Entomologist.*" At present among North American entomological journals it is second only to the *Transactions of the American Entomological Society* in longevity. On page 22 of the initial number (*Can. Ent.* 1: 22, 1868) is a contribution from W. H. Edwards "*Papilio Machaon in British America.*" This was the first of over 170 papers from Edwards' pen to appear in the journal.

AN ANNOTATED LIST OF THE LYCAENIDAE (LEPIDOPTERA: RHOPALOCERA) OF THE WESTERN HEMISPHERE

BY WILLIAM PHILLIPS COMSTOCK AND EDGAR IRVING HUNTINGTON

Continued from LXVIII (2), p. 122

hadros Cook, John H. and Frank E. Watson, *Incisalia*
Type Locality: Houston, Texas.
Location of Type: Type destroyed. (Paratypes in American Museum of Natural History; United States National Museum.)
Original Description: 1909 (June), Can. Ent., vol. 41, p. 181 (Guelph, Ontario).
Additional Reference: Holland, W. J., 1931, The Butterfly Book, Revised Edit., p. 226, pl. 64, fig. 46 (♂ paratype) (Garden City, N. Y.).

hagmanni Röber, J. *Eumaeus*
Type Locality: Obidos, Brazil.
Location of Type:
Original Description: 1923, Ent. Zeit., vol. 84, p. 95 (Stettin).
Note: Probably synonym of *Eumaeus minijas* Hübner.

hahneli Staudinger, Otto, *Thecla*
Type Locality: Upped Amazon and Iquitos, Peru.
Location of Type: Staudinger Collection.
Original Description: 1888, Exotische Schmetterlinge, vol. 1, p. 286, vol. 2, pl. 97 (Bayern).
Additional Reference: Druce, H. H. 1907 (June), Proc. Zool. Soc. London, p. 614 (London). (Makes *hahneli* a synonym of *centoripa* Hewitson.)
Note: We recognize *hahneli* as being distinct from *centoripa*.

halala Hewitson, W. C., *Thecla*
Type Locality: Amazon.
Location of Type: British Museum (Natural History).
Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 7 (London).
Additional References: Hewitson, W. C., 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 175, vol. 2 pl. 69, figs. 508, 509 ♀ (London). Druce, H. H., 1907 (June), Proc. Zool. Soc. London, p. 591 (London). Makes *halala* a synonym of *leucophaeus* Hübner.)

halciones Butler, A. G. and Herbert Druce, *Tmolus*
Type Locality: Cartago, Costa Rica.
Location of Type: British Museum (Natural History).
Original Description: 1872 (July), Cistula Entomologica, vol. 1, p. 108 (London).

Additional References: Butler, A. G., 1873 (October), Lepid. Exot., p. 161., pl. 57, fig. 9 ♂ (London). Godman, F. D. and O. Salvin, 1887 (August), Biologia Centrali-Americana, Insecta Lepidoptera-Rhopalocera, vol. 2, p. 61, (London). (Make *halciones* a synonym of *empusa* Hewitson.)

halesus Cramer, Pierre, *Papilio*
Type Locality: Virginia, U. S. A.
Location of Type:
Original Description: 1777, Papillons exotiques des trois parties du monde, vol. 2, p. 3, pl. 98, figs. B, C (Amsterdam).
Synonyms: *dolichos* Hübner, *juanita* Scudder.
Subspecies: *corcorani* Gunder, *estesi* Clench syn.

hamila Jones, E. Dukinfield, *Thecla*
Type Locality: Castro, Paraná, Brazil.
Location of Type: Jones Collection.
Original Description: 1912, Proc. Zool. Soc. London, p. 896, pl. 97, fig. 1 (London).

hamo Lucas, P. H., *Lycaena*
Type Locality: Havana, Cuba.
Original Description: 1857, in Sagra, Historie physique, politique et naturelle de l'ile de Cuba, vol. 7, p. 612 (Paris).
Additional Reference: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 57 (New York, N. Y.). (Removed *hamo* from synonymy of *hanno* Stoll but did not recognize the species.)

hanno Stoll, Caspar, *Papilio*
Type Locality: "Surinam and the Cape of Good Hope."
Location of Type:
Original Description: 1790, in Cramer, Papillons exotiques des trois parties du monde, Supplement, p. 170, pl. 39, figs. 2, 2b (Amsterdam).
Additional References: Hübner, J., 1812, Sammlung exotischer Schmetterlinge, vol. 1, pl. (98), figs. 1–4 (Augsburg). d'Almeida, R. F., 1933, Lambillionea, vol. 33, pp. 230–236 (Paris). Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 104 (New York, N. Y.).
Subspecies: *watsoni* Comstock and Huntington, *ceraunus* Fabricius, *antibubastus* Hübner, *pseudoptiletes* Boisduval and *LeConte*, syn., *bogotana* Draudt, *filenus* Poey, *astenidas* Lucas syn., *astenidia* Draudt, syn.

harietta Draudt, Max, *Thecla* (not Weeks) Misspelling of *harrietta* Weeks.
Type Locality:
Location of Type:
Original Description: 1919 (November), The Macrolepidoptera of the World, vol. 5, p. 750 (Stuttgart).

harrietta Weeks, A. G. Jr., *Thecla*
Type Locality: Near "Corioco," Bolivia, April 19, 1899.

Location of Type: Museum of Comparative Zoology, no. 16,673.

Original Description: 1901 (November), Can. Ent., vol. 33, p. 294 (London, Ontario).

Additional References: Weeks, A. G. Jr., 1905, Illus. of Diurnal Lepidoptera, p. 45, pl. 11, fig. 2 (Boston, Mass.). Draudt, Max (as *harietta*), 1919 (November), The Macrolepidoptera of the World, vol. 5, p. 750 (Stuttgart). (Makes *harrietta* a subspecies of *paupera* Felder.)

Synonyms: *harietta* Draudt.

hassan Stoll, Caspar, *Papilio*

Type Locality: Surinam.

Location of Type:

Original Description: 1791, in Cramer, Papillons Exotiques des trois parties du monde, Supplement, p. 168, pl. 38, figs. 4, 4D ♂ (Amsterdam).

Additional Reference: Hewitson, W. C. 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 202 (London). (Makes *hassan* Stoll synonym of *janias* Cramer.)

havila Hewitson, W. C., *Thecla*

Type Locality: New Granada.

Location of Type: British Museum (Natural History).

Original Description: 1865, Illus. of Diurnal Lepidoptera, vol. 1, p. 76, vol. 2, pl. 30, figs. 23, 24 ♂ (London).

heathii Fletcher, James, *Thecla*

Type Locality: Long River valley, near Cartwright, Southern Manitoba, July.

Location of Type: United States National Museum.

Original Description: 1903, Trans. Royal Soc. Canada, Section 4, p. 211, fig. (Ottawa).

Additional References: Fletcher, James, 1904 (May), Can. Ent., vol. 36, no. 5, p. 125, pl. (♀) (London, Ontario). Stallings, Don B. and J. R. Turner, 1943, Ent. News, vol. 54, p. 131, pl. 2 (Philadelphia, Pa.). (Places *heathii* as an aberration of *falacer* Godart.)

hebraeus Hewitson, W. C., *Thecla*

Type Locality: Bahia.

Location of Type: British Museum (Natural History). (Boisduval Collection.)

Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 104, vol. 2, pl. 43, figs. 165, 166 ♂ (London).

hecale Godman, F. D. and O. Salvin, *Thecla* Misspelling of *hecate* G. & S.

Type Locality:

Location of Type:

Original Description: 1887 (October), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 3, pl. 58, figs. 15–17 (London).

hecale Godman, F. D. and O. Salvin, *Thecla*

Type Locality: Jalapa, Mexico.

Location of Type: British Museum (Natural History).

Original Description: 1887 (October), Biologia Centrali-Americana, Insecta, vol. 2, p. 98, vol. 3, pl. 58, figs. 15, 16 ♂, 17 ♀ (as *hecale*) (London).
Synonyms: *hecale* Godman and Salvin.

helenae dos Passos, Cyril F., *Incisalia augustus*
Type Locality: Doyles Station, Newfoundland.
Location of Type: American Museum of Natural History.
Original Description: 1943 (June), Amer. Mus. Novitates, no. 1230, p. 2 (New York, N. Y.).

helios Edwards, William H., *Lycaena*
Type Locality: California.
Location of Type:
Original Description: 1871 (January), Trans. Amer. Ent. Soc., vol. 3, p. 208 (Philadelphia, Pa.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 27, no. 455 (Los Angeles, Calif.). (Places *helios* as a subspecies of *icarioides* Boisduval.)
Synonyms: *helius* (Zool. Record).

helius, Lycaena Misspelling of *helios* Edwards
Type Locality:
Location of Type:
Original Description: 1873, Zool. Record, vol. 8, p. 365 (London).

helloides Boisduval, Jean A., *Polyommatus*
Type Locality: Neighborhood of San Francisco, California.
Location of Type: United States National Museum?
Original Description: 1852, Ann. Soc. Ent. France, Series 2, vol. 10, p. 291 (Paris).
Additional Reference: Oberthür, Charles, 1913 (October), Etudes de Lepidopterologie Comparee, fasc. 9, pt. 1, p. 40, pl. 236, figs. 1927 ♂ 1928 ♀ (Rennes).
Synonyms: *castro* Reakirt, *sternitzkyi* Gunder, *williamsi* Gunder.
Subspecies: *florus* Edwards, *hulbirti* Field syn.

heloisa Möschler, H. B., *Thecla*
Type Locality: Paramaribo, Surinam (1 ♀).
Location of Type:
Original Description: 1883, Verh. Zool.-bot. Ges., vol. 32, p. 309, pl. 17, fig. 2 (Wien).

hemon Cramer, Pierre, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1775, Papillons exotiques des trois parties du monde, vol. 1, p. 30, pl. 20, figs. D, E (Amsterdam).
Synonyms: *acmon* Cramer.

hena Hewitson, W. C., *Thecla*
Type Locality: Nicaragua.

Location of Type: British Museum (Natural History).

Original Description: 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 171, vol. 2, pl. 67, figs. 486, 487 ♀ (London).

Note: Hewitson, *ibid,* makes *mena* a synonym of *coelicolor* Butler and Druce.

henrici Grote, Augustus R. and Coleman T. Robinson, *Thecla*

Type Locality: Philadelphia, Pennsylvania.

Location of Type: American Museum of Natural History.

Original Description: 1867 (July), Trans. Amer. Ent. Soc., vol. 1, p. 174 (Philadelphia, Pa.).

Subspecies: *margaretae* dos Passos, *solatus* Cook and Watson, *turneri* Clench.

henryae Cadbury, John W. 3rd, *Chrysophanus snowi*

Type Locality: Caribou Pass, British Columbia, alt. 5200 ft., July 26, 1932.

Location of Type: Academy of Natural Science, Philadelphia, no. 7779 (1 ♀).

Original Description: 1937, Proc. Acad. Nat. Sci., Phila., vol. 89, p. 409, pl. 16, fig. 9 (Philadelphia, Pa.).

heodes Druce, Hamilton H., *Thecla*

Type Locality: Uramarca ♂, San Marcas ♀, Dept. Ancachs, North Peru.

Location of Type: H. J. Adams Collection.

Original Description: 1909 (September), Trans. Ent. Soc. London, p. 437, pl. 11, figs. 10 ♂, 11 ♀ (London).

heraclides Godman, F. D. and O. Salvin, *Thecla*

Type Locality: Cache, Costa Rica.

Location of Type: British Museum (Natural History).

Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 71, vol. 3, pl. 56, figs. 26, 27 (London).

heraldica Dyar, Harrison G., *Thecla*

Type Locality: Porto Bello, Panamá.

Location of Type: United States National Museum, no. 15,761.

Original Description: 1915, Proc. U. S. Natl. Mus., vol. 47, p. 151 (Washington, D. C.).

herii, Lycaena amyntula var. Misspelling of *herrii* Grinnell

Type Locality:

Location of Type:

Original Description: 1902, Zool. Record, vol. 38, p. 207 (London).

hermes Edwards, William H., *Chrysophanus*

Type Locality: California (1 ♂, 1 ♀).

Location of Type:

Original Description: 1870 (January), Trans. Amer. Ent. Soc., vol. 3, p. 21 (Philadelphia, Pa.).

Synonyms: *del sud* Wright.

herodotus Fabricius, Johann Christian, *Hesperia*
Type Locality: "In Indiis".
Location of Type:
Original Description: 1793, Entomologica Systematica, vol. 3, p. 286 (Hafniae).
Additional References: Donovan, Edward, 1800, Ins. India, p. 42, pl. 39, fig. 2 (London). Hewitson, W. C., 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 205, vol. 2, pl. 82, fig. 680 (London). Godman, F. D. and O. Salvin, 1887 (May), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 33, vol. 3, pl. 52, figs. 3, 4 ♂, 5 ♀ (London.
Synonyms: *lucania* Hewitson.

herri Field, William D., *Habrodias grunus*
Type Locality: McKenzie (Sister's) Pass, Oregon, August 28, 1936.
Location of Types: United States National Museum? William D. Field Collection.
Original Description: 1938, Bull. So. Calif. Acad. Sci., vol. 37, pt. 1, p. 29 (Los Angeles, Calif.).

herrii Grinnell, Fordyce Jr., *Lycaena amyntula* var.
Type Locality: Cochise County, Arizona, July, 1899 and September, 1900.
Location of Type: Grinnell Collection?
Original Description: 1901 (July), Can. Ent., vol. 33, p. 192 (London, Ontario).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 27, no. 477 (Los Angeles, Calif.). (Places *herrii* as a subspecies of *comyntas* Godart.)
Synonyms: *arizonensis* Gunder, *herii* (Zool. Record), *jemezensis* Gunder.

hesperitis Butler, A. G. and Herbert Druce, *Bithys*
Type Locality: Cartago, Costa Rica.
Location of Type: British Museum (Natural History). (Druce Collection.)
Original Description: 1872 (July), Cistula Entomologica, vol. 1, p. 107 (London).
Additional Reference: Butler, A. G., 1873 (October), Lepid. Exot., p. 159, pl. 57, fig. 14 (London).
Synonyms: *perdistincta* Kaye, *lugubris* Möschler, *cabiria* Hewitson syn.

hesseli Rawson, George W. and J. Benjamin Ziegler, *Mitoura*
Type Locality: Lakehurst, Ocean County, New Jersey, May 1, 1949.
Location of Type: United States National Museum.
Original Description: 1950 (June), Jour. New York Ent. Soc., vol. 58, p. 74, pl. X, figs. 5–9 (Lancaster, Pa.).

hesychia Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Río Sucio, Costa Rica.

Location of Type: British Museum (Natural History).
Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 87, vol. 3, pl. 57, figs. 32, 33 ♂ (London).

heteronea Boisduval, Jean A., *Lycaena*
Type Locality: Mountains of Northern California, June.
Location of Type: United States National Museum?
Original Description: 1852, Ann. Soc. Ent. France, Series 2, vol. 10, p. 298 (Paris).
Additional Reference: Oberthür, Charles, 1913 (October), Etudes de Lepidopterologie Comparee, fasc. 9, pt. 1, p. 41, pl. 237, figs. 1946 ♂, 1947 ♀ (Rennes).
Synonyms: *coloradensis* Gunder.
Subspecies: *gravenotata* Klots, *klotsi* Field.

hewitsoni Kirby, W. F., *Thecla*
Type Locality: Mexico.
Location of Type: British Museum (Natural History).
Original Description: 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 386, no. 117 (London).
Note: A new name for *Thecla ira* Hewitson.
Synonyms: *ira* Hewitson.

hicetas Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Cordova, Mexico.
Location of Type: British Museum (Natural History).
Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 87, vol. 3, pl. 57, figs. 34, 35 ♂ (London).

hilda Grinnell, Joseph and Fordyce Grinnell, Jr., *Cupido*
Type Locality: Upper cienega at the head of the South Fork of the Santa Ana, 8,500 ft., June 27–28, 1905.
Location of Type: American Museum of Natural History.
Original Description: 1907 (March), Jour. New York Ent. Soc., vol. 15, no. 1, p. 46 (Lancaster, Pa.).

Additional References: Coolidge, Karl R., 1911 (May), Pomona College Jour. Ent., vol. 3, no. 2, p. 512 (Claremont, Calif.). (Makes *hilda* a synonym of *daedalus* Behr. This is incorrect.) McDunnough, J. H., 1938, Check list, pt. 1, p. 27, no. 453 (Los Angeles, Calif.). (Places *hilda* as a subspecies of *saepiolus* Boisduval.)
Synonyms: *garthi* Gunder.

hirsuta Prittwitz, O. V., *Thecla*
Type Locality: Corcovado, Rio de Janeiro, Brazil.
Location of Type:
Original Description: 1865, Stettin Ent. Zeit., vol. 26, p. 321 (Stettin).

hisbon Godman, F. D. and O. Salvin, *Thecla*
Type Locality: ♂ Central Guatemala, ♀ Costa Rica.
Location of Type: British Museum (Natural History).
Original Description: 1887 (May), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 17, vol. 3, pl. 49, figs. 4, 5 ♂, 6 ♀ (London).
Additional Reference: Draudt, Max, 1919, The Macrolepidoptera of the World, vol. 5, p. 749 (Stuttgart). (Makes *hisbon* a synonym of *lisus* Stoll.)

homoperplexa Barnes, William and F. H. Benjamin, *Callophrys apama* race
Type Locality: Golden, Colorado, May 24–30 .
Location of Type: Barnes Collection, United States National Museum. (Paratype in American Museum of Natural History.)
Original Description: 1923, Contributions to the natural history of the Lepidoptera of North America, vol. 5 p. 68 (Decatur, Ill.).

hosmeri Weeks, A. G. Jr., *Thecla*
Type Locality: Suapure, Venezuela.
Location of Type: Museum of Comparative Zoology.
Original Description: 1906 (June), Ent. News, vol. 17, p. 198 (Philadelphia, Pa.).
Additional Reference: Weeks, A. G. Jr., 1911, Illus. of Diurnal Lepidoptera, vol. 2, p. 5, pl. 3, fig. 3 (Boston, Mass.).

hostis Schaus, William, *Thecla*
Type Locality: Nova Friburgo, Brazil.
Location of Type: United States National Museum, no. 5950 ♂.
Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 420 (Washington, D. C.).

hugo Doubleday, Edward, *Thecla* Misspelling of *hugon* Godart
Type Locality: Brazil.
Location of Type:
Original Description: 1847, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 2, p. 32 (London).
Additional Reference: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 54 (New York, N. Y.). (Consider *hugo* a misspelling of *hugon* Godart, and a synonym of *endymion* Fabricius.)

hugon Godart, J. B., *Polyommatus*
Type Locality:
Location of Type: Paris Museum. (Photograph in American Museum of Natural History.)
Original Description: 1822, Encyclopédie Méthodique, vol. 9, p. 640 (Paris).
Additional References: Godman, F. D. and O. Salvin, 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 75 (London). (Said: "The Florida form *T. hugon* of Godart, having

scarcely any blue at all on those (secondary) wings." They made it a form of *beon* Cramer, probably based on the supposed Paris type which might be *beon* according to the photograph in the American Museum of Natural History.) Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 54 (New York, N. Y.). (Place *hugon* as a synonym of *endymion* Fabricius.)

huguenini Gunder, J. D., *Glaucopsyche xerces mertila* ♂ ab.
Type Locality: San Francisco, California, April 24, 1917.
Location of Type:
Original Description: 1925 (January), Ent. News, vol. 36, p. 3, pl. 1, fig. O (Philadelphia, Pa.).

hulbirti Field, William D., *Lycaena dorcas* race *florus* ♀ f.
Type Locality: Broadwater County, Montana, July 30, 1930.
Location of Type: William D. Field Collection. United States National Museum?
Original Description: 1936, Jour. of Ent. Zool., vol. 28, p. 25 (Claremont, Calif.).

humber Schaus, William, *Thecla*
Type Locality: Cucuta, Venezuela.
Location of Type: United States National Museum, no. 5957 ♀.
Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 422 (Washington, D. C.).

humuli Harris, Thaddeus William, *Thecla*
Type Locality: Massachusetts.
Location of Type:
Original Description: 1841, Report on the Insects of Massachusetts Injurious to Vegetation, p. 215 (Cambridge, Mass.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 24, no. 373 (Los Angeles, Calif.). (Places *humuli* as a synonym of *melinus* Hübner.)

huntingtoni Rindge, Frederick H. and William P. Comstock, *Echinargus*
Type Locality: Hololo Mountain Road, St. Ann's, Trinidad, B. W. I., March 21–31, 1929.
Location of Type: American Museum of Natural History.
Original Description: 1953 (June), Jour. New York Ent. Soc., vol. 61, p. 99 (Lancaster, Pa.).

hyacinthus Cramer, Pierre, *Papilio*
Type Locality: "Indes Occidentales".
Location of Type:
Original Description: 1775, Papillons exotiques des trois parties du monde, vol. 1, p. 59, pl. 36, fig. E (Amsterdam).

hyas Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Mexico, Guatemala (Vera Paz), Costa Rica, Panamá (Chiriquí).
Location of Type: British Museum (Natural History).

Original Description: 1887 (May), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 27, vol. 3. pl. 51, figs. 5 ♀, 6, 7 ♂ (London).

Additional Reference: Draudt, Max, 1919 (December), The Macroleipdoptera of the World, vol. 5, p. 753, pl. 149-b (Stuttgart). (Makes *hyas* a form of *tolimides* Felder.)

hybla Druce, Hamilton H., *Thecla*

Type Locality: Ecuador.

Location of Type: British Museum (Natural History).

Original Description: 1907 (June), Proc. Zool. Soc. London, p. 578, pl. 33, fig. 4 ♂ (London).

hyccara Hewitson, W. C., *Thecla*

Type Locality: Amazon.

Location of Type: British Museum (Natural History).

Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 7 (London).

Additional Reference: Hewitson, W. C., 1873 (February), Illus. of Diurnal Lepidoptera, vol. 1, p. 145, vol. 2, pl. 57, figs. 361, 362 ♂ (London).

hygela Hewitson, W. C., *Thecla*

Type Locality: None given.

Location of Type: British Museum (Natural History).

Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 30 (London).

Additional Reference: Hewitson, W. C., 1873 (February), Illus. of Diurnal Lepodoptera, vol. 1, p. 146, vol. 2, pl. 58, figs. 367, 368 ♂ (London). Brazil.

hyllus Butler, A. G., *Chrysophanus* (not Cramer).

Type Locality: Coldwater near Orilla, Canada West.

Location of Type:

Original Description: 1870, Catalogue of Diurnal Lepidoptera Described by Fabricius in the Collection of the British Museum, p. 173 (London).

Note: This is a misidentification by Butler of *thoe.*

hyperici Boisduval, Jean A. and John LeConte, *Thecla*

Type Locality: Georgia and Florida.

Location of Type:

Original Description: 1833, Historie Générale et iconographie des Lépidoptères et des chenilles de l'Amérique Septentrionale, p. 90, pl. 28 (Paris).

Note: Godman, F. D. and O. Salvin, 1887, Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 92 (London), make *hyperici* a synonym of *milinus* Hübner.

Additional Reference: Oberthür, Charles, 1920, Etudes de Lepidopterologie Comparee, fasc. 17, p. 15, pls. p. 7, pl. DV, fig. 4208 (Rennes).

hyprocrita Schaus, William, *Thecla*

Type Locality: Tuis, Juan Vinas, Costa Rica.

Location of Type: British Museum (Natural History).

Original Description: 1913 (September), Proc. Zool. Soc. London, p. 352, pl. 52, fig. 6 ♂ (London).

hypophlaeas Boisduval, Jean A., *Polyommatus*

Type Locality Northern California and Northern United States.

Location of Type: United States National Museum?

Original Description: 1852, Ann. Soc. Ent. France, Series 2, vol. 10, p. 291 (Paris).

Synonyms: *neui* Rummel, *obliterata* Scudder, *octomaculata* Dean, *adrienne* Maynard, *americana* Harris, *bacchus* Scudder, *banksi* Watson and Comstock, *caeca* Reiff, *fasciata* Strecker, *fulliolus* Hulst, *fulvus* Rummel, *bulbus* (Zool. Record).

Subspecies: *arethusa* Wolley Dod, *feildeni* M'Lachlan.

hypoxanthe Kirby, W. F., *Chrysophanus*

Type Locality: Polish Ukraine.

Location of Type: British Museum (Natural History).

Original Description: 1862, Manual European Butterflies, p. 91, fig. 11 ♀ (London).

Additional References: Kirby, W. F., 1871, Synonymic Catalogue of Diurnal Lepidoptera, p. 343, no. 22 (London). (Questions the Ukraine locality). McDunnough, J. H., 1938, Check list, pt. 1, p. 26, no. 434 (Los Angeles, Calif.). Places *hypoxanthe* in the synonymy of *epixanthe* Boisduval and LeConte.)

hypsea Godman, F. D. and O. Salvin, *Thecla*

Type Locality: Chiriquí, Panamá.

Location of Type: Staudinger Collection.

Original Description: 1887 (May), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 38, vol. 3, pl. 52, figs. 20, 21 ♂ (London).

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Edited by WM. S. CREIGHTON

Publication Committee

FRANK A. SORACI HERBERT F. SCHWARZ

PETER FARB

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Officers for the Year 1960

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HERBERT FERLANDO SCHWARZ

Journal of the New York Entomological Society

Vol. LXVIII DECEMBER No. 4

HERBERT FERLANDO SCHWARZ

1883–1960

With the death on October 2, 1960, of Mr. Schwarz, the New York Entomological Society suffered the grievous loss of one of its best loved and most influential members; and the world lost a distinguished entomologist, naturalist, explorer, and writer.

Herbert Ferlando Schwarz was born September 7, 1883, on Fire Island, New Lork. He received his secondary schooling at Phillips Exeter Academy, and went on to Harvard, which gave him an A.B. in 1904 and an A.M. in Philosophy in 1905. In 1907 Columbia University awarded him an A.M. in English and Comparative Literature.

But by this time his interest in scientific exploration was asserting itself. In 1904 he made a trip to New Mexico to visit and study the Indians of that region. Returning west in 1905 to Walpi, Arizona, he witnessed the Hopi Indian Antelope and Snake dances. Subsequently he visited the Navajos on their reservation. He made extensive notes on his observations, but in later years we could rarely draw him out of his great personal modesty to tell us any of his stirring adventures.

In 1910 he married Dorothy Constable, who survives and is living in their apartment on Park Avenue. They have four daughters: Mrs. Barbara French, Mrs. Eleanor Stock, Mrs. Dorothy Hines, and Miss Marjorie Schwarz. Mrs. Schwarz always took an active interest in all of her husband's many interests, sometimes going with him on trips or to scientific meetings.

From 1909 to 1919 Mr. Schwarz was associated with G. P. Putnam & Sons as head of their Editorial Department and member of the board. His work involved the supervision of some of

the books being prepared for publication. One of these books changed his entire life. This was *The Field Book of Insects* by Dr. Frank E. Lutz, then Curator of the Entomology Department at the American Museum of Natural History. It fell to Mr. Schwarz to work with Dr. Lutz in the book's preparation. The two became so intrigued with their work that a life-long friendship developed. Their collaboration resulted in one of the finest handbooks on insects, which after forty years is still the outstanding book of its kind. It has undoubtedly started more people toward an acquaintance with insects than any other one book. It also brought to the American Museum of Natural History a man who for many years to follow, and until his death, was to be an outstanding figure in the activities of the Museum.

In 1919 Mr. Schwarz spent three months in parts of Colorado and adjacent states as a volunteer assistant to an expedition from the Museum's Entomology Department. In 1921 he was appointed a Research Associate to the Department, an appointment which he retained until his death. In 1921 and continuing to 1925 he was editor of *Natural History Magazine,* and did much to make this popular publication what it is today.

Now began a long series of trips to various parts of the country to collect insects for the Museum. These trips were sometimes made alone, but more frequently with Dr. Lutz and Mr. Irving Huntington. In 1923 he was in southern Florida; in 1925, the Brownsville region of Texas; in 1930, Barro Colorado Island and the Canal Zone, to which he returned in 1938.

In 1935 he visited the Cauca Valley in Colombia for an extensive collecting trip, during which he studied the biology of the Hymenoptera, particularly of the stingless bees. In pursuit of this special interest Mr. Schwarz went to central Mexico and Yucatan in 1946, and to southern Mexico the next year. He also visited natural history museums in various parts of the world.

After the death of Dr. Lutz in 1943, Mr. Schwarz was appointed Acting Chairman of the Entomology Department, where he served very ably, making himself beloved by all who worked with or met him.

Herbert Schwarz joined the New York Entomological Society in 1919, serving on many committees, and as Vice President in 1933 and President in 1935. He took a keen interest in the Society, and on numerous occasions helped it out financially.

He also gave generously of his time and money to other scientific interests. From 1925 to 1936 he was Editor of Publications for the New York Academy of Science. He was a long-time Fellow of this organization and on its Council for many years. He also served on the Plan and Scope Committee of the National Audubon Society.

Fond of horse-back riding he was long a member of Squadron A, with headquarters in the Old Armory. Although very modest, this was one phase of his life that he enjoyed reminiscing about. Since Squadron A was frequently called out for parades and other occasions, amusing things were certain to happen. A long period of inactivity might be followed by a long parade. Then, stiff and sore and even blistered, they would still have to clean and curry their horses, clean the leather and polish the brass, all under the sharp eyes and sharper tongue of their commanding officer. As might be expected, Mr. Schwarz served in the First World War in the Field Artillery.

Another of his very great interests was the Explorers Club which he joined in 1921. Here too, he served on many committees, especially on the Admissions Committee, of which he was chairman for many years; and on the board, where his able judgment, keen mind, and courteous manner made him one of the most respected men around the Club.

Two other clubs of which he was a proud and interested member were the Harvard and the Century Association.

In his earlier years he also found time for numerous business connections. One of these was the F.A.O. Schwarz toy company, which had been founded by his father, and of this he remained a director until his death.

Mr. Schwarz wrote extensively, both scientific and popular material. He has over 60 titles to his credit; most of the later publications on stingless bees. His scientific studies culminated in a monumental work, *Stingless Bees* (*Meliponidae*) *of the Western Hemisphere,* published in 1948.

All who speak of Herbert Schwarz remark on his kindness, his gentleness, his generosity. He was a gentleman of the old school. We shall miss him.—JOHN C. PALLISTER, AMERICAN MUSEUM OF NATURAL HISTORY.

NOTES ON STRYMON CARYAEVORUS McDUNNOUGH (LEPIDOPTERA, LYCAENIDAE)

By ALEXANDER B. KLOTS
THE CITY COLLEGE OF NEW YORK AND THE AMERICAN MUSEUM OF NATURAL HISTORY

Ever since its recognition and naming (McDunnough, 1942) *Strymon caryaevorus* has remained little known and less understood. The original specimens were reared from larvae from Merivale, Ontario (the type locality) and Aylmer, Quebec. Since the larvae were not recognized as something new or important, no detailed information was recorded about them or the pupae. The original description stated merely that "the hickory feeders were more evenly pale green without much trace of darker dorsal or lateral markings," the comparison being with larvae of *S. falacer* (Godart). The implication was also made that the larvae of *S. falacer* feed only on oak, those of *S. caryaevorus* on hickory (*Carya*). The distinctiveness of the male genitalia was mentioned but not described.

In 1942 Michener and dos Passos corrected the implication that *S. falacer* is not a hickory feeder, and also mentioned the "rather constantly smaller stigma of [the male] *caryaevorus.*" In both of these matters they were correct. They recorded specimens of *caryaevorus* in the American Museum collection from Jefferson Lake, Lesueur Co., Minnesota, and Johnstown, New York, and figured the male genitalia.

In 1950 Clench recorded the capture in Michigan of adult *caryaevorus* flying in company with *falacer,* visiting various flowers (*Daucus carota* and *Asclepias* sp.) and resting on leaves. To anticipate, in 1958 Clench recorded *caryaevorus* from the Powdermill Nature Reserve in western Pennsylvania.

In 1951 Klots briefly characterized *caryaevorus* and distinguished it from other eastern North American *Strymon,* figuring an adult male and summarizing what was known about the species.

In 1952 Klots and Clench, in naming *Strymon kingi* and discussing its genitalic characteristics, briefly described the distinctive features of the male and female genitalia of *caryaevorus.*

LIFE HISTORY NOTES

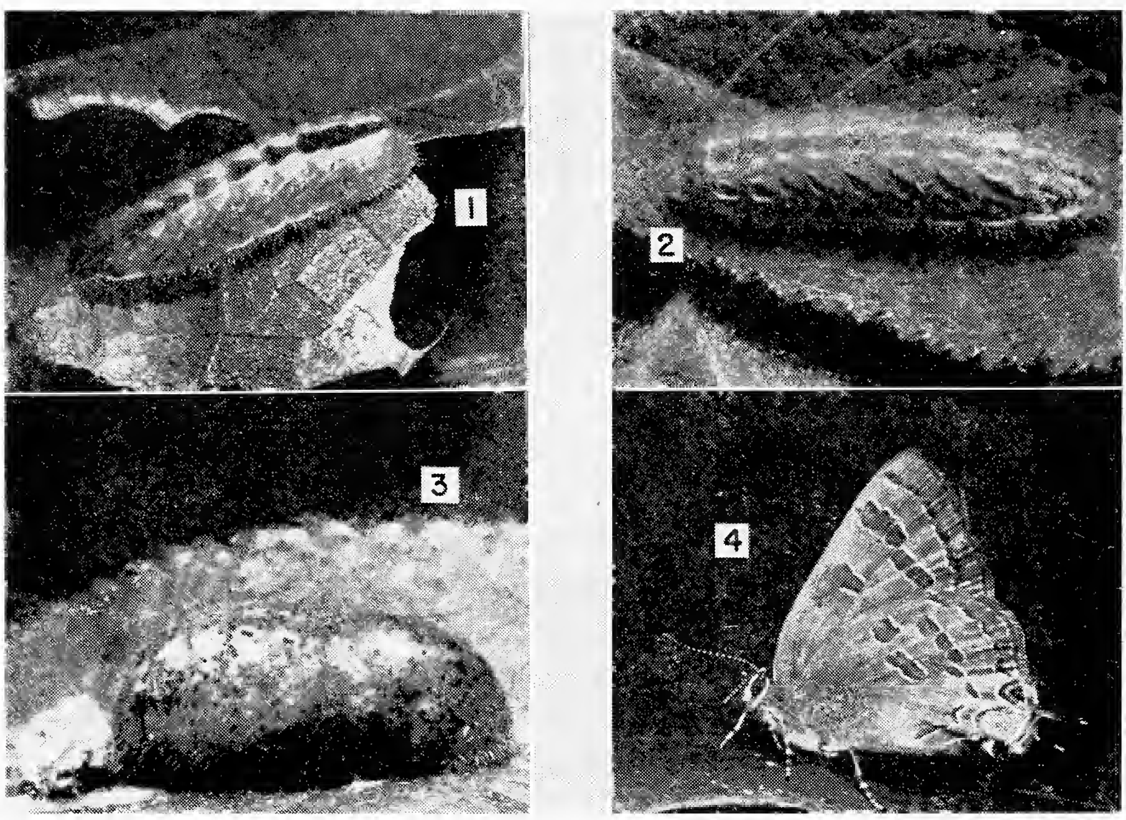
On 31 May 1959, at the Fairchild Botanic Garden of the Audubon Society Nature Sanctuary near Greenwich, Fairfield Co., Connecticut, during a New York Entomological Society field trip, the writer found five *Strymon* larvae. These were on a small hickory about five feet high that was identified as *Carya glabra* (Mill.) Spach. by Mr. Lester Bradley, the Audubon Society botanist. One larva was in bad condition, appearing to have been punctured or parasitized (perhaps the victim of cannibalism) and soon died. The other four were successfully reared through, pupating 7 June (♂ no. 1), 7 June (♂ no. 2), 6 June (♀ no. 1) and 7 June (♀ no. 2); and emerging from the pupae 14 June (♂ no. 1), 15 June (♂ no. 2), 13 June (♀ no. 1) and 14 June (♀ no. 2). The genitalia of all have been checked, so that their identification as *caryaevorus* is certain. Fortunately the larvae were recognized as distinctive, so that descriptions and color photographs were made of them and the pupae. The larval description that follows is something of a composite of all four specimens; but they showed extremely little variation. Very likely they were siblings.

LAST INSTAR LARVA (fig. 2). Head green; clypeus, labrum, a small patch surrounded by the ocelli, and mouthparts, brown. (In Scudder's key to *Thecla* (i.e. *Strymon*) larvae (Scudder, 1889, p. 874) these larvae would run on the head coloration to *calanus* (i.e. *falacer*). Prothorax green with vague, faint darker and lighter markings, the "bald patch" concolorous. General ground color of thorax and abdomen yellowish-green. From anterior edge of mesothorax to end of abdomen a broad, dark green, mid-dorsal line, with little change in width throughout its length, through which the "heart" shows plainly. On either side of this a whitish, sub-dorsal line, half as wide. On mesothorax, metathorax and abdominal segments 1–6, markings on each side going laterad and ventrad, as follows: laterad of the whitish sub-dorsal line a narrower, yellow-green line; then a whitish-green line which, near the posterior edge of each segment, bends and slants ventrad to the edge of the segment, and is much thicker just posterior to the middle of each segment; then a prominent, dark green, diagonal line; then a greenish-white diagonal line (especially prominent on meso- and metathorax) narrowing toward the posterior edge of each segment; then a dark green diagonal line, not quite reaching the posterior edge of the segment because the greenish-white line above it runs down there; then an indistinct, more yellowish-green line, scarcely diagonal, in which are the whitish spiracles; below this a narrow, darker green, longitudinal line; below this, along the lateral edge of the body, a light line that is yellowish on the anterior segments and becomes broader and whitish posterad. This light

lateral line continues posterad and runs almost around the posterior edge of the abdomen. Below it the ventral surface, leg bases and prolegs are dark green. The honey gland opening is plainly visible as a dark, transverse slit on abdominal segment 7. No papillae or other special structures were seen associated with the honey gland opening.

When found, one of the larvae was in a slight, irregular, silken web that loosely bound together a couple of leaflets; but this may have been only incidental, and the web the product of a pyralid larva that was common on the same plant. In captivity the larvae fed chiefly on the lower surfaces of leaves. When found they were feeding on small, very immature leaves; but these were the only leaves available at that time, and they showed no such preference later in captivity. The pupae were formed attached to leaf surfaces by both a posterior silk pad and a slight girdle.

The most outstanding differences between this larva and that



1. Mature larva, *Strymon falacer* (Godart); anterior end to right. Fairchild Botanical Garden, Greenwich, Conn., 18 May 1957.

2. Mature larva, *Strymon caryaevorus* McDunnough; anterior end to left. Fairchild Botanical Garden, Greenwich, Conn., 2 June 1959.

3. Pupa, *Strymon caryaevorus*, the same individual as the larva of Fig. 2.

4. Adult male, *Strymon caryaevorus*, the same individual as the larva and pupa of Figs. 2 and 3.

The photographs of *S. caryaevorus* are not equally magnified.

of *S. falacer* concern the mid-dorsal space and the sub-dorsal lines bordering it, and the lateral diagonal markings. In *falacer* (Fig. 1) the sub-dorsal lines tend to diverge strongly from each other toward the posterior edge of each segment, so that the mid-dorsal space tends to be a series of isosceles trapezoids with their broader bases posterad; while in *caryaevorus* the mid-dorsal space tends to be relatively parallel-sided, even in width and continuous throughout its entire length. In some *falacer* larvae the mid-dorsal trapezoids are all filled in with brownish, as in the specimen figured; but in others only one or more of the anterior and of the posterior ones are thus dark, the middle ones being concolorous green. The writer has seen only one (of some fifteen) *falacer* larvae that had no dark mid-dorsal spots.

The diagonal lateral markings of *caryaevorus* are more prominent than those of *falacer,* particularly the diagonal dark green lines about midway between the sub-dorsal line and the lateral edge; and, especially on the meso- and metathorax, the greenish-white diagonal lines laterad of these. Critical comparisons of many more larvae of various genetic strains and from other localities will eventually have to be made. It may be noted that in McDunnough's original characterization the *caryaevorus* larvae were mentioned as lacking dark dorsal and lateral markings as compared with those of *falacer.*

The pupae of even the commonest species of *Strymon* are so poorly known in detail that the writer hesitates to attempt to characterize those of *caryaevorus.* The four pupal and last larval exuvia are preserved for future reference in the collection of the American Museum. In Scudder's very incomplete key (*l.c.*, p. 874) they would run to "*calanus*" (e.g. *falacer*), having relatively short body hairs, and at least many tiny, wart-like elevations at the junctions of the raised ridges that form a fine network on the body.

ADULT CHARACTERIZATION

Because of individual variation (chiefly of *falacer*) it is not always possible, for the writer at least, to feel sure of identifications of adult *caryaevorus* by color and pattern. In this connection 54 *caryaevorus* and more than 400 *falacer* were studied; all of the *caryaevorus,* and all of the *falacer* about which there was any doubt, were checked by genitalic examination. The char-

acters discussed below should serve for the distinction of 80 to 90 percent of all specimens of both species; but all about which there is the least doubt should be checked by the genitalia, which offer completely reliable diagnostic characters.

On the dorsal surface of the wings the stigma at the end of the discal cell of the male is slightly more slender and distally tapering in *caryaevorus;* in *falacer* its distal end is more broadly rounded.

On the ventral surface of the wings (Fig. 4) are a number of important characters. In *caryaevorus* the spots of the postmedian row are wider (at least costad), better developed, and form a more broken and "offset" line than in *falacer.* Occasional aberrant *falacer,* however, show much widening and irregularity in this line. In *caryaevorus* the three most costad large spots, in cells R_5 M_1 and M_2 (there is a trace of a still more costad spot in cell R_4) are usually much wider than the succeeding ones toward the inner margin. These three spots form one group; the two in cells M_3 and Cu_1 form another group; and finally the two fused spots in cell Cu_2 (+1A) form a third group. In *caryaevorus* these groups tends to be offset, breaking the smooth continuity of the row: the lower spot of the first group is often displaced half or more its width marginad than the upper one of the second group; and the lower spot of the second group is similarly displaced more marginad than the fused spot below it. In *falacer* this row is usually much more even in width and less broken and offset. In *caryaevorus* the basad white borders of these spots are more often present, and the spots often contain a very faint, central shade of a slightly more orange brown. The submarginal spots of the fore wing tend to be slightly more prominent in *caryaevorus,* sometimes even showing a faint trace of a light distal edge.

On the hind wing of *caryaevorus* the most costad of the postmedian row of spots tends to have its basal and distal edges curved, concave distally; and to occupy an almost median position between the base and margin of the wing. In *falacer* this spot tends strongly to have straighter basal and distal edges and to lie relatively more toward the outer margin, so that it seldom overlaps the double discocellular spot below it. The large, blue patch in cell Cu_2 tends to be relatively longer baso-distally in *caryaevorus,* a feature that is especially noticeable in its relation to the continguous, orange and black spot in cell Cu_1, which tends

to be smaller baso-distally. In *caryaevorus* the white inner edge of the blue spot usually touches vein Cu_2 considerably basad of the point where the white inner edge of the orange and black spot touches the same vein; while in *falacer* the white inner edges of the two spots may touch vein Cu_2 at almost the same point, that of the blue spot seldom being more than two or three scale-rows more basad. This very useful distinguishing character was pointed out to me by Gordon Small Jr., after his study of the very fine series of *caryaevorus* taken by him at Riverside, Connecticut (see below).

It must be stressed again that, because of the considerable amount of individual variation in *caryaevorus* and *falacer,* particularly in the latter, none of the pattern characters is as completely trustworthy as those of the genitalia.

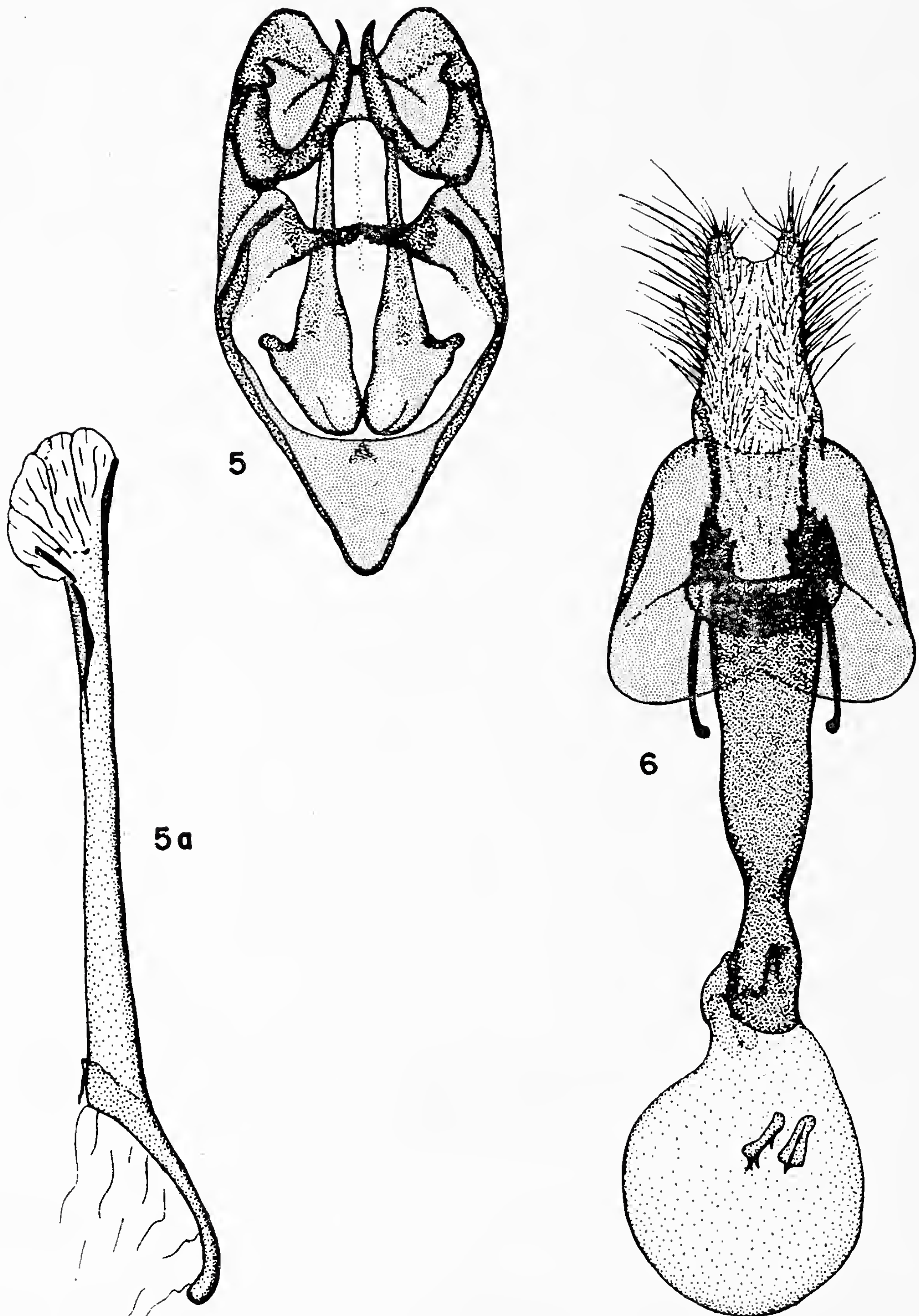
GENITALIC CHARACTERS

Fortunately there are easily seen and completely reliable characters for distinguishing *caryaevorus* and *falacer* in both the male and female genitalia. The female genitalia can be distinguished without dissection by merely brushing away the vestiture at the end of the abdomen. The most distinctive character of the male genitalia can be seen on most specimens only on dissection; but it is rendered plainly visible if the genitalia of a fresh specimen are gently grasped with fine-pointed forceps and pulled outward so as to be mostly visible. Carefully done, this harms the specimen not at all, and is a procedure that enables quick, positive identification of many hairstreaks.

The most distinctive feature of the *caryaevorus* male genitalia (fig. 5 and 5a) is the possession of a pair of prominent, small-spined, processes that project mesad from the ventro-caudal angles of the tegumen, lying ventro-caudad of the valvae and aedeagus and meeting in the mid line or overlapping. In *falacer* there are only slight rudiments of these processes. They are well developed, but not as large as in *caryaevorus,* in *Strymon liparops* (Boisduval & Leconte). In comparison with *falacer, caryaevorus* has the arms of the gnathos ('falces'') somewhat stouter, the valvae more slender and the saccus narrower and more tapering.

The most distinctive feature of the *caryaevorus* female genitalia (fig. 6) is the possession of a flat, heavily sclerotized, prominently projecting, toothed process on either side of the ostium bursae. Sometimes these are merely simply pointed; but usually

they bear several teeth. There is nothing at all like this in *falacer*, which has merely a simple, slightly projecting, curved ridge (lamella postvaginalis) at the caudal edge of the ostium. In addition, in comparison with *falacer*, *caryaevorus* appears to



5. Male genitalia, *Strymon caryaevorus*, ventro-caudal aspect, aedeagus removed. Jefferson Lake, Lesueur Co., Minn., 14 July 1915.

5a. Aedeagus of same, lateral aspect.

6. Female genitalia, *Strymon caryaevorus*, ventral aspect. Greenwich, Conn., reared on *Carya glabra*, ex pupa 13 June 1959.

have the papillae anales slightly more slender, the ductus bursae a little stouter, and a more heavily sclerotized, complex cervix bursae that bends strongly dorsad so as to make the corpus bursae lie far in the dorsal part of the abdomen. It is worth noting that the male genitalia, while giving no very definite evidence, are in general more like those of *falacer* (and *edwardsii* (Saunders)) than of any other Eastern *Strymon.* Although the spinous processes of the tegumen might indicate a relationship to *liparops,* the writer feels that they probably arose independently. The female genitalia, in the proportions of the ductus bursae and the structures of the cervix bursae, seem to indicate a fairly close relationship to *falacer* (and *edwardsii*).

GEOGRAPHIC RANGE

S. caryaevorus is known from several localities in central and eastern Ontario and Quebec, Vermont, Minnesota, Michigan, Pennsylvania, New York, Connecticut, New Jersey and Kentucky. Its distribution seems largely to coincide with that of the biotic formation variously known as the Great Lakes forest; the Great Lakes-St. Lawrence region; the Upper Transition Zone; or as an ecotone between the deciduous and the boreal, needle-sclerophyll forests. It would be interesting to know if it occurs in the more or less isolated area of this formation between the western end of Lake Superior and Lake of the Woods. The records in the New York City–Connecticut region and southward are somewhat more to the south of this biotic formation, being in what is essentially an ecotone between the northern deciduous forest and the Mississippi Valley or the coastal plain. The writer has seen but one New Jersey specimen, a female from Newton, Sussex Co., 27 June, 1959, leg. Gordon Small, Jr. This specimen was taken in an "old field" environment where a colony of *Lephelisca borealis* (Grote & Robinson) also occurred. About eighty other New Jersey specimens examined were all *falacer.* Two specimens from Mt. Vernon, Rockcastle Co., Kentucky, 13 June, 1959, leg. L. J. Sanford, have been checked by genitalia; so has one from near Mt. Equinox, Vermont, 5–6 July 1959, leg. C. F. dos Passos. The writer has heard of records from Maryand, Ohio and Indiana which there is no reason to doubt, but has not seen the specimens.

In June, 1959, Gordon Small Jr., collected over 30 specimens of *caryaevorus* at Riverside, Fairfield Co., Connecticut, only a few

miles from Greenwich. The writer has checked the genitalia of about a dozen of these, confirming Mr. Small's identification of them. The coincidence of the simultaneous discovery of the species in 1959 in southern Connecticut and New Jersey led at first to the belief that *caryaevorus* had made a sudden, great extension of its range southward. However, the recognition of a hitherto misidentified specimen of *caryaevorus* in the American Museum collection from Yonkers, New York, July, 1934 (ironically, collected by the writer) shows that *caryaevorus* has been in the New York City region for a long time, and that 1959 was merely an unusually good year for it (and for collectors). Yet, such extremely thorough local collectors as Cook, Watson, W. P. Comstock and Buchholz never found it! It is certainly very "local," occurring in small, probably widely separated colonies. Collectors will do well to keep this in mind, and never to take for granted that *caryaevorus* does not occur in any suitable locality where *Carya* grows.

ACKNOWLEDGMENTS

The writer is greatly indebted to Messrs. F. M. Brown, R. L. Chermock, Harry Clench, C. F. dos Passos and Gordon Small, Jr. for the loan of many of the specimens studied; and to Mr. Small for the gift of a set of the Connecticut *caryaevorus*, and of the New Jersey specimen, to the American Museum.

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THE DATES OF PUBLICATION OF THE PARTS OF "IRIS"

BY LOUIS S. MARKS
BIOLOGICAL LABORATORIES
FORDHAM UNIVERSITY

The proper dating of an original description and other lesser citations whether to establish priority or to insure bibliographic accuracy is a major function of a working taxonomist.

Much pioneer work has been done in this country by the researches of Comstock, Brown and dos Passos. In England, the work of Hemming and Griffiths in this field has been noteworthy. The number of misdated works is much larger than is usually imagined and each year brings more examples to light. It is impossible to do precise and accurate taxonomic work until these discrepancies have been cleared.

While searching for and verifying the original descriptions of the Papilionidae of New Guinea, especially those described by Hans Fruhstorfer, it became necessary to examine the journal "*Iris*" in some detail.

"*Iris*" started publication as the *Correspondenz-Blatt des Entomologischen Vereins "Iris" zu Dresden.* Its first volume was published in leisurely fashion covering the years 1884–1888. It became necessary to reprint No. 1 of Volume 1 and this reprint appeared on November 15, 1888. The first volume and the reprint part were all printed in Dresden. The title of Volume 2, No. 1, is *Deutsche Entomologische Zeitschrift herausgegeben von der Gesellschaft "Iris" in Dresden in Verbindung mit der Deutscher Entomologischen Gesellschaft.* And Vol. 2, No. 2, adds after the Gesellschaft, *zu Berlin.* From Vol. 2 on, the printing was done in Berlin and the famous book-selling firm of Friedlander seems to have taken on the responsibility of publication. Its correct citation is the *Deutsche Entomologische Zeitschrift "Iris".* It is, however, very often cited as just "*Iris*".

It soon became apparent that of the 53 volumes of "*Iris*", 35 of these volumes had portions which were misdated. This stems from the fact that like many journals which are organs of societies, "*Iris*" is cited by "Jahrgang". And the assumption is

always made that the "Jahrgang" coincide with the volume. This is not so in the case of "*Iris*" sixty percent of the time.

While this is the major problem, there are many others such as the assignment of particular pages to a particular date and the assignment of plates to a particular date.

The editors of "*Iris*" were of uneven caliber, although this seems to have plagued the journal all through its existence. During its existence "*Iris*" had 11 editors (Table 1).

"IRIS" EDITORS

Vol. 1, No. 1	Stoehr
Vol. 1, No. 2 and 3	C. A. Hamann
Vol. 1, No. 4 and 5	Dr. Erich Haase
Vol. 2—Vol. 10	Dr. O. Staudinger
Vol. 11	H. Calberla
Vol. 12—Vol. 25	Carl Ribbe
Vol. 26—Vol. 27	Dr. P. Denso
Vol. 28—Vol. 38	Dr. Hans Walther
Vol. 39—Vol. 41	Dr. K. M. Heller
Vol. 42—Vol. 49	Dr. Fritz van Emden
Vol. 50—Vol. 53	Dr. K. Gunther

TABLE I

The problem is particularly important in correctly dating the publications of Hans Fruhstorfer. Fruhstofer published a minimum of 53 papers in this journal alone. He had the very bad habit of publishing descriptions purported to be the original description in two journals at the same time, and it is very important to be able to date the descriptions as accurately as possible.

"*Iris*" contains many papers on Lepidoptera which are monographic or revisional in scope. The information herein should enable the taxonomist to properly date any descriptions, citations or plates in "*Iris*".

Fortunately, the American Museum of Natural History possesses a complete run in the binding of which the wrappers have been included. This was the set that was examined in great detail.

The author wishes to acknowledge with thanks the permission of the Trustees of the American Museum of Natural History for the privilege of using the library and the collections of that institution. He is especially grateful to Dr. Frederick H. Rindge,

Associate Curator of Lepidoptera at the Museum for many helpful suggestions and for critically reading the manuscript.

THE DATES OF PUBLICATION OF THE PARTS OF "IRIS"

VOL.	JAHRGANG	PART	PAGES	PLATES	DATE	NOTES
1	—	1	1–16	—	Oct. 1, 1884	1, 2
1	—	2	17–32	I	May 1, 1885	
1	—	3	33–110	II–V	Mar. 1, 1886	
1	—	4	111–206	VI–IX	June 15, 1887	
1	—	5	207–340	X–XII	July 1, 1888	
2	1889	1	1–186	I–IV	Aug., 1889	3, 4
2	1889	2	187–282	V	Mar., 1890	4
3	1890	1	1–208	I, II	Sept., 1890	5
3	1890	2	209–338	III, IV	End of Dec., 1890	
4	1891	1	1–192	I, II	End of July, 1891	
4	1891	2	193–348	III, IV	Mid. Feb., 1892	
5	1892	1	1–272	I	End of June, 1892	
5	1892	2	273–464	II–VII	End of Dec., 1892	
6	1893	1	1–144	I–III	July 8, 1893	
6	1893	2	145–382	IV–VII	Jan. 3, 1894	
7	1894	1	1–192	I–IV	July 14, 1894	
7	1894	2	193–376	VIII, IX	Jan. 5, 1895	
7	1894	—	—	V–VII	Before July 15, 1895	
8	1895	1	1–288	I–III, map	July 15, 1895	
8	1895	2	229–387	IV–VIII	Jan. 2, 1896	6
9	1896	1	1–224	I, II	July 18, 1896	
9	1896	2	225–405	III–VIII	Jan. 9, 1897	7
10	1897	1	1–184	I–VI	July 27, 1897	
10	1897	2	185–412	VII–XII	Jan. 12, 1898	
11	1898	1	1–208	IV	Aug. 10, 1898	
11	1898	2	209–410	I–III, V, VI, map	Feb. 10, 1899	7
12	1899	1	1–268	I–IV	Sept. 15, 1899	
12	1899	2	269–418	V–IX	Mar. 25, 1900	7
13	1900	1	1–160	I–IV	Aug. 15, 1900	7
13	1900	2	161–362	V–VIII, portrait	Feb. 20, 1901	7
14	1901	1	1–195	I–III	Oct. 5, 1901	
14	1901	2	197–393	IV, V	Mar. 1, 1902	7, 8
15	1902	1	1–181	I–III, V–VII	Sept., 1902	
15	1902	2	183–360	IV	May 1, 1903	
16	1903	1	1–246	I, II	Oct. 1903	
16	1903	2	247–398	III–VI	Mar. 20, 1904	
17	1904	1	1–168	I–IV	Oct. 5, 1904	
17	1904	2	169–323	V–IX	July 25, 1905	
18	1905	1	1–236	I–II	June 1, 1905	

VOL.	JAHR-GANG	PART	PAGES	PLATES	DATE	NOTES
18	1905	2	237–332	III–X	Mar. 6, 1906	9
19	1906	1	1–48	—	May 10, 1906	
19	1906	2	46–98	I–II	July 1, 1906	
19	1906	3	97 (sic!)–134 (sic!)	III–IV	Sept. 15, 1906	10
19	1906	4	145–250	V–VIII	May 15, 1907	
20	1907	1, 2	1–140	I–IV	Aug. 1, 1907	11
20	1907	3	141–255	VI, VII	Oct. 12, 1907	
20	1907	4	257–295	—	Feb. 26, 1908	12
21	1908	1	1–80	I	Apr. 1, 1908	
21	1908	2	81–176	II, III	June 1, 1908	
21	1908	3	177–240	—	Sept. 10, 1908	
21	1908	4	241–330	IV–VI	Apr. 14, 1909	
22	1909	1	1–74	—	Apr. 1, 1909	
22	1909	2, 3	75–202	—	Sept. 15, 1909	11
22	1909	4	203–314	I–XXVIII A–D	Jan. 1, 1910	13
23	1909–1912	1	1–96	—	July 20, 1909	14
23	1909–1912	2	97–146	—	Nov. 5, 1910	
23	1909–1912	3, 4	147–395	I, II	Feb. 29, 1912	11
24	1910	1	1–16	I	Jan. 1, 1910	15
24	1910	2	17–26	—	Feb. 1, 1910	
24	1910	3	27–58	—	Mar. 1, 1910	
24	1910	4	59–74	II, III, IV	Apr. 1, 1910	
24	1910	5	75–104	—	May 1, 1910	
24	1910	6, 7	105–154	—	June 6, 1910	11
24	1910	8, 9	155–182	V–XIII	July 15, 1910	11
24	1910	10	183–208	—	Aug. 15, 1910	
24	1910	11, 12	XIII–XXIV	XIV	Jan. 20, 1911	11
25	1911	1	1–8	—	Jan. 20, 1911	16
25	1911	2	9–24, I–IV	—	Feb. 1, 1911	
25	1911	3	25–40	—	Mar. 1, 1911	
25	1911	4	41–56	—	Apr. 1, 1911	
25	1911	5	57–72	—	May 1, 1911	
25	1911	6	73–80	—	June 1, 1911	
25	1911	7, 8	89–101	—	Aug. 1, 1911	
25	1911	9	101–112	—	Sept. 1, 1911	
25	1911	10, 11	113–126	—	Nov. 1, 1911	11
25	1911	12	127–140	—	Jan. 15, 1912	
26	1912	1	1–101	I–V	Apr. 23, 1912	17
26	1912	2	103–138	—	June 29, 1912	
26	1912	3	139–189	—	Oct. 8, 1912	
26	1912	4	191–235	VIII, VI	Jan. 14, 1913	18

VOL.	JAHRGANG	PART	PAGES	PLATES	DATE	NOTES
				(sic!), VII		
27	1913	1	1–45, I–IV	I, II	Apr. 9, 1913	19
27	1913	2	47–110, V, VI	—	Aug. 20, 1913	
27	1913	3	111–145 VII–X	—	Oct. 14, 1913	19, 20
27	1913	4	145–178, VII–XXIII	—	Jan. 31, 1914	20
28	1914	1	1–80	I–III, map	Mar. 31, 1914	21
28	1914	2	81–176	—	June 30, 1914	
28	1914	3	177–272	IV	Sept. 30, 1914	
28	1914	4	273–290	—	Dec. 31, 1914	
29	1915	1	1–48	—	May 10, 1915	
29	1915	2, 3	49–184	—	Oct. 1, 1915	11
29	1915	4	185–208	—	Jan. 10, 1916	
30	1916	1	1–96	—	May 1, 1916	22
30	1916	2, 3	97–152	—	Sept. 1, 1916	11
30	1916	4	153–222	I, II	Mar. 1, 1917	
31	1917	1, 2	1–68	—	July 1, 1917	11, 21
31	1917	3, 4	69–144	—	Feb. 1, 1918	11, 21
32	1918	1, 2	1–94	I–III	Sept. 1, 1918	11, 21
32	1918	3, 4	95–139	IV, 3 maps	Feb. 15, 1919	11, 21
33	1919	1, 2	1–64	—	June 1, 1919	11, 21
33	1919	3, 4	65–146	—	Dec. 31, 1919	11, 21
34	1920	1, 2	1–180	—	June 30, 1920	11, 21
34	1920	3, 4	181–274	—	Dec. 15, 1920	11, 21
35	1921	1, 2	1–86	—	Apr. 30, 1921	11, 21
36	1921	3, 4	87–191	—	Dec. 15, 1921	11, 21
36	1922	1, 2	1–44	I–XVII	May 15, 1922	11, 21
36	1922	3, 4	45–109	—	Nov. 30, 1922	11, 21
37	1923	1, 2	1–51	—	June 15, 1923	11, 21, 23
37	1923	3, 4	53–92	—	Dec. 31, 1923	11, 21
38	1924	1	1–57	—	June 15, 1924	21
38	1924	2, 3	59–222	—	Nov. 1, 1924	11, 21
38	1924	4	223–280	—	Jan. 15, 1925	21
39	1925	1, 2	1–64	—	Apr. 1, 1925	11, 21
39	1925	3	65–180	—	Aug. 1, 1925	21
39	1925	4	181–246	—	Dec. 1, 1925	21
40	1926	1	1–68	—	Mar. 15, 1926	21
40	1926	2, 3	69–154	—	July 15, 1926	11, 21
40	1926	4	155–220	—	Dec. 15, 1926	21
41	1927	1	1–82	—	Apr. 15, 1927	21
41	1927	2	63–172	—	July 1, 1927	21
41	1927	3	173–204	—	Sept. 1, 1927	21
41	1927	4	205–239	—	Dec. 15, 1927	21

VOL.	JAHR-GANG	PART	PAGES	PLATES	DATE	NOTES
42	1928	1	1–80	—	Mar. 28, 1928	
42	1928	2	81–248	I–V	June 27, 1928	
42	1928	3	249–296	VI–VIII	Sept. 25, 1928	
42	1928	4	297–338	IX	Dec. 15, 1928	
43	1929	1	1–48	I, II	Mar. 27, 1929	
43	1929	2	49–96	—	June 15, 1929	
43	1929	3	97–144	—	Sept. 25, 1929	
43	1929	4	145–198	III–V	Jan. 15, 1930	
44	1930	1	1–48	—	Mar. 20, 1930	
44	1930	2	49–96	I	June 16, 1930	
44	1930	3	97–144	—	Oct. 8, 1930	
44	1930	4	145–198	II, III	Dec. 31, 1930	
45	1931	1	1–48	I, II	Mar. 31, 1931	
45	1931	2	49–112	—	June 26, 1931	
45	1931	3	113–160	III	Sept. 15, 1931	24
45	1931	4	161–214	—	Dec. 19, 1931	
46	1932	1	1–48	—	Apr. 20, 1932	
46	1932	2	49–96	—	July 9, 1932	
46	1932	3	97–144	I, II	Oct. 12, 1932	
46	1932	4	145–198	—	Dec. 17, 1932	
47	1933	1	1–48	—	Mar. 25, 1933	
47	1933	2	49–96	I	June 15, 1933	
47	1933	3	97–144	—	Sept. 20, 1933	
47	1933	4	145–198	II	Jan. 31, 1934	
48	1934	1	1–48	—	Apr. 7, 1934	
48	1934	2	49–96	—	June 30, 1934	25
48	1934	3	97–144	I, II	Oct. 6, 1934	26
48	1934	4	145–198	III	Jan. 12, 1935	
49	1935	1	1–48	—	Apr. 12, 1935	
49	1935	2	49–96	I	July 4, 1935	
49	1935	3	97–144	—	Oct. 5, 1935	
49	1935	4	145–198	II	Feb. 1, 1936	
50	1936	1	1–48	I, II	May 9, 1936	
50	1936	2	49–96	III	Aug. 8, 1936	
50	1936	3	97–144	—	Oct. 19, 1936	
50	1936	4	145–198	IV	Jan. 30, 1937	
51	1937	1, 2, 3	1–136	—	July 31, 1937	27
51	1937	4	137–198	—	Dec. 31, 1937	28
52	1938	1	1–50	I	May 15, 1938	
52	1938	2	50–98	—	Aug. 1, 1938	
52	1938	3, 4	99–192	—	Feb. 1, 1939	11
53	1939	1	1–48	—	July 1, 1939	
53	1939	2	49–88	—	Oct. 1, 1939	

NOTES

(1) There is no "Jahrgang" for Vol. I.

(2) There was a reprint second edition, Nov. 15, 1888.

(3) The break between Parts 1 and 2 can be determined by the footnote on Page 187.

(4) The dates are determined from the preserved wrapper.

(5) This is the first volume in which an editorial note on actual date of publication of the various parts appears. It usually on the verso of the table of contents page issued to subscribers at the end of the year. Because of its inconspicuous place, it may be easily overlooked.

(6) The Friedlander date at the foot of the wrapper is 1895 while the publication date on the cover is clearly marked Jan. 2, 1896.

(7) The Friedlander date at the foot of the wrapper is in error.

(8) There is no Page 196.

(9) The covers of Part 2 call for 10 plates; there are only 8.

(10) There are two pages marked 97 and two pages marked 98. Page 134 at the end of Part 3 should read 144.

(11) Double number.

(12) There is no numbered Page 256, although the leaf is occupied by a book review.

(13) An examination of the wrappers shows that all 28 color plates and the four lettered double plates must be assigned to Part 4.

(14) The entire Volume 23 is *Beitrage zu einer Lepidopteren Fauna von Andalusian.* The special parts are called "Beiheften" in contrast to the "Heften" which make up the usual volumes of *"Iris."* Volume 23 was issued simultaneously with parts of Volume 22, all of Volumes 24 and 25, and part of Volume 26. It is specified by the editor (Ribbe) that these "Beiheften" are to be considered as Volume 23. The designation of page numbers to the various parts of this volume is a difficult problem. There is no indication on the wrappers or any editorial direction as to the pages which comprise each part. The assignment of page numbers has been done on the basis of internal textual evidence. Page 97 carries a 1910 citation. This citation is in connection with an "Anmerkung" to a bibliography. It is obvious, therefore, that the two sections of the bibliography were published at different times. Page 225 carries a 1910 reference and therefore must be in part 3–4. There are an unusually high number of 1909 references after Page 147 compared with the pages before. Page 147 has a reference to a paper by Fruhstorfer published on October 17, 1908. It furthermore seems to be a natural "breakpoint" for this section because of the diagrams of the genitalia.

(15) The publication dates of the *Korrespondenzblatt* appended in this volume to *"Iris"* are always dated the first of the month. The wrappers tell a different story, and we can on the basis of the wrappers assign the proper dates to the *Korrespondenzblatt.* The first five numbers give no trouble. They were published in the first five numbers of *"Iris"* and the dates coincide. *Korrespondenzblatt* 6 was published with date June 1, 1910, in *"Iris"* 6, 7 dated June 6, 1910. *Korrespondenzblatt* 7 was published with date July 15 in *"Iris"* 8, 9. The date is correct. *Korrespondenzblatt* 8 was published with date Aug. 1, 1910, in "Iris" part 10 which was issued Aug. 15, 1910.

Numbers 9 through 12 give no indication on the wrappers of when they were published or distributed. The possibility exists that they were mailed separately to subscribers. This is possible, but not probable, in view of the mode of issue of the first 8 numbers, i.e., attached to parts of *"Iris."* Double part 11 and 12 contained only 13 pages of non-reading text-indices, etc., and one plate (XIV). It seems reasonable to assume that the bulk of the double number 11–12 was made up of *Korrespondenzblatt* Nos. 9–12. The correct date of publication for these parts is therefore Jan. 20, 1911.

(16) Dated from wrappers. No editorial information on the date of publication.

(17) The wrappers disagree with the editorially assigned dates. The wrapper dates: Part 1—April 15, 1912; Part 2—June 30, 1912; Part 3—September 30, 1912; Part 4—Dec. 31, 1912. Inasmuch as the editor prepared the title page for the volume *after* the issuance of the parts, the editorial dates are the correct ones and are so designated in the text. This was Dr. Denso's first year as editor in place of Carl Ribbe, and this probably accounts for the bibliographic problems posed by this volume.

(18) The numbering of the plates is inconsistent. The wrapper for Part 4 calls for Plates VII and VIII. In the copy in the Library of the American Museum of Natural History, the plates are bound VIII, VI and the color plate VII. Because of the great care taken in accurate binding and collation at the Museum, it may reasonably be assumed that this was the actual mode of issue. See Note 17 above for the probable explanation.

(19) The wrappers disagree with the editorially assigned dates. The wrappers date Part 1—March 31, 1913; Part 3—September 30, 1913. The reasons given in Note 17 indicate the reason for the use of the date in the text.

(20) Page 145 which originally had as its verso Page VII (a book review) is a cancelled page. Because of the excellent policy at the Library of the American Museum of Natural History of preserving things of this nature, we can see that the text of the cancelled Page VII and its replacement differ. Page 145 is the recto of Page VII. The text differs on Page VIII but not on Page 145. This was Dr. Denso's last year as editor.

(21) While the dates for the publication of the parts are given in the usual editorial note, the pagation of the parts is not given. This has been deduced from the wrappers.

(22) The single title page is dated March 1, 1917, which is the date of Part 4. The wrappers have therefore been used to date the individual parts.

(23) The wrapper gives the date as June 30, 1923, the editorial note at June 15, 1922. The latter obviously is a typographical error for the year date.

(24) Plate III exists in two states. This was announced to subscribers on a small orange slip asking for an extra remittance if they desired Part 3 with the hand-colored plate. This slip is preserved in the bound volume in the Library of the American Museum of Natural History. The wrapper of Part 3 has a note indicating the two states of the plate. The copy in the American Museum of Natural History has the black and white plate.

(25) The editorial note in error cites this as Part 3.

(26) Plate I exists in two states. Subscribers were charged an extra fee for the hand-colored state. The copy in the American Museum of Natural History Library is a black and white one.

(27) A triple number.

(28) The copies of Volumes 51, 52 and 53 exist only in wrappers in the American Musuem of Natural History.

NOTES ON NEOTROPICAL ARADIDAE XI (HEMIPTERA)

By Nicholas A. Kormilev
Brooklyn, N.Y., U.S.A.

Through the kind offices of Dr. Carl J. Drake, Washington, D.C.; Dr. Halaszfy Eva, Budapest; Mr. Fritz Plaumann, Nova Teutonia, Santa Catarina, Brazil; and Dr. Reece I. Sailer, Washington, D.C., I had an opportunity to study a certain number of Neotropical Aradidae, among which were found a few new species, and one new genus, described below. I express to them my sincere gratitude.

Subfamily MEZIRINAE Oshanin, 1908

Genus *Bergrothiessa* Usinger & Matsuda, 1959

Bergrothiessa plaumanni, new species

Male. Allied to *Bergrothiessa intermediaria* (Kormilev), 1953, but slightly bigger, tergum is more convex, not so flat; the whole upper surface of the body, with exception of the pronotum, is roughly punctured. Apterous.

Head. As long as wide through the eyes (male 28:29, female 30:30); anterior process strong, with parallel sides, anteriorly deeply cleft, jugae being much longer than the tylus, reaching to the middle of the first antennal segment. Antenniferous tubercles strong, dentiform, barely divaricating, reaching to ¼ of the first antennal segment. Eyes relatively small, exerted; postocular border rounded, and with a small, round tubercle in the middle. Vertex with "V"-form granulate carinae. Antennae strong, more than twice as long as the head (male 60:28, female 63:30). Proportions of the antennal segments (1–4) are: male 17:10:24:9. female 18:11:24:10. Rostral groove is deep and narrow, posteriorly closed; rostrum does not reach the hind border of the same.

Pronotum. Subpentagonal, shorter than wide across the humeri (male 17:42, female 20:47). Collum fine, anteriorly cut out; antero-lateral angles form a slightly obtuse angle; lateral borders straight, divergent backward, and carinate; posterior border subangularly protruding backward; disc with a "T"-shaped median sulcus, which occupies the hind ⅔ of the median line; laterad of it run two (1 + 1) feebly marked longitudinal carinae, evanescent before reaching the fore, and hind, borders of the pronotum; laterad of them are situated two (1 + 1) blurred longitudinal carinae, and between the latter and the carinate lateral borders are placed two (1 + 1), rather deep, longitudinal furrows.

MESONOTUM. In the form of a broad "V," much shorter than wide (male 14:53, female 15:62); median line with two parallel longitudinal carinae; the disc slightly inflated on both sides, and roughly punctured; laterally, at a certain distance from the lateral border, with a longitudinal furrow, prolongation of that of the pronotum.

METANOTUM. Very short in the middle (male 4:56, female 5:65); inflated, and roughly punctured laterally, somewhat elevated at the median line.

ABDOMEN. Longer than wide (male 74:62, across segment V, female 90:82, across segment IV); tergum I clearly separated from the metanotum and CDP (central dorsal plate, in this genus formed by segments II to VI); the disc of CDP inflated; depressed on both sides of the median line on tergum III, with a rounded median elevation, or tumor on tergum IV, and with a spearhead-shaped elevation on terga V and VI. Tergum VII raised backward for the reception of the hypopygium in the male; raised and depressed in the middle in the female. Connexivum is broad, with carinate exterior borders, which are more or less straight, only PE-VII (postero-exterior angles) are with a small, round tubercle. Spiracles II to V ventral, placed far from the border; VI sublateral, not visible from above, VII sublateral, but visible, and VIII lateral. Hypopygium of the male is semiglobose, rounded posteriorly, and with a triangular elevation at the base, reaching to ⅔ of the median line, tapering backward. Lobes of VIII almost reach to the tip of the hypopygium. In the female, lobes of VIII are triangular, reaching to ¾ of IX, the latter incised in the middle posteriorly.

COLOR. Piceous; spearhead elevation of CDP, and connexiva partly, pale yellow; antennae II and III, and tibiae, reddish brown; scent gland openings, rostrum, and coxae brown; tarsi yellow.

TOTAL LENGTH. Male 4.73, female 5.16 mm.; width of the pronotum: male 1.4, female 1.6 mm.; width of the abdomen: male 2.07, female 2.73 mm.

Holotype: male, Itayuba, S. Catarina, Brazil—F. Plaumann coll. IV, 58; deposited in the collection of the author.

Allotype: female, collected with the holotype; in the collection of Mr. F. Plaumann.

It is a pleasure to dedicate this species to Mr. Fritz Plaumann, who had collected so many new species of Aradidae.

Key to the species of *Bergrothiessa*.

I. MALES.

1. Hypopygium is pyriform .... *B. rufa* Kormilev
   Hypopygium is globose, or subglobose 2
2. Hypopygium is very large, wider than the head through the eyes .... *B. grossa* Kormilev
   Hypopygium is smaller, narrower than the head, wide through the eyes 3
3. Hypopygium with a triangular elevation at the base, reaching to ⅔ of the median line; exterior borders of connexivum VII straight .... *B. plaumanni* new species

Hypopygium with a transverse sulcus at the middle of the upper surface; exterior borders of connexivum VII roundly cut out .... *B. intermediaria* (Kormilev)

II. FEMALES. 1. Lateral borders of the pronotum form an obtuse angle; lateral borders of mesonotum with a round lobe *B. usingeri* (Wygodzinsky)

Lateral borders of the pronotum straight; lateral borders of mesonotum without lobe 2

2. Lobes of VIII are large, triangular, reaching to the tip of IX; exterior borders of connexiva VI and VII without tubercles .... *B. grossa* Kormilev

Lobes of VIII do not reach the tip of IX; at least connexivum VII with a small, round tubercle 3

3. Only connexivum VII has a round tubercle, placed at PE-angles; the tip of IX with a single angular notch *B. plaumanni* new species

Connexiva VI and VII with small, sublateral, round tubercles; the tip of IX with double notch *B. intermediaria* (Kormilev)

I could not examine the male of *B. usingeri* (Wygodzinsky); the female of *B. rufa* Kormilev is unknown yet.

Halaszfya, new genus

Closely allied to *Coloborrhynus* Bergroth, 1906, the main difference being in straight, heavily incrustated, hairs forming fringes on different parts of the body. In the keys for Mezirinae of Usinger & Matsuda (1959: 200) it runs to *Coloborrhynus* also, but as I had never seen, or heard, that the species with fringes of heavily incrustated hairs, and without them, belong to the same genus, at least in Aradidae, I decided to describe these two curious species, and establish for them a new genus.

Small, ovate. Head slightly shorter, or as long as wide through the eyes. Anterior process long and broad, apically cleft, laterally with a fringe of heavily incrustated bristles, which make it look much wider than it is; similar bristles, but shorter, and dispersed, are also on the upper surface of the process; process reaches to ¾ of the first antennal segment. Antenniferous tubercles flat, apically pointed. Eyes relatively big, exerted, almost globose; postocular tubercles small dentiform, do not reach the outer border of the eyes. Infraocular carinae with a row of incrustated bristles; vertex with a quadruple row of similar, erect bristles; lateral shelves naked. Antennae short, less than twice as long as the head; the first segment clavate, and covered with dispersed, inclined bristles, but without incrustation; the 2d more, the 3d less, widening toward the tip; the 4th pyriform; the first and the 3d subequal in length, the 4th a little shorter, the 2d the shortest, ¾

times as long as the first. Rostral atrium slightly open; rostral groove wide, very deep, and posteriorly closed; rostrum tiny, does not reach the hind border of the groove.

PRONOTUM. About half as long as wide across the humeri; collum distinctly separated from the pronotum; the fore lobe of the pronotum slightly narrower, and lower than the hind lobe; antero-lateral angles regularly rounded, and with a horizontal fringe of long, incrustated bristles; fore disc with two (1 + 1) anteriorly convergent callous spots, only at their fore border provided with short, erect, incrustated bristles; laterad of them with two (1 + 1) curved ridges, provided with a double, or triple, row of erect bristles. Interlobal depression with a deep and narrow sulcus. Hind disc with a dispersed, rough granulation; the hairs on the granules are very short. Lateral borders of the hind disc subparallel between themselves, convergent anteriorly; hind border slightly and widely cut out.

SCUTELLUM. Triangular, shorter than wide at the base; rimmed from all sides; median ridge narrow and granulate; disc transversely rugose in the hind ⅔ of its length.

HEMELYTRA. Complete, reaching (female) to the fore border of tergum VII. The baso-lateral borders of corium straight, slightly reflexed, and divergent backward; postero-lateral borders narrowly rimmed, and roundly cut out; disc with granulate veins; apical angle of the corium angularly rounded; apical border slightly convex, and barely cut out interiorly. Membrane big, with somewhat obsolete venation.

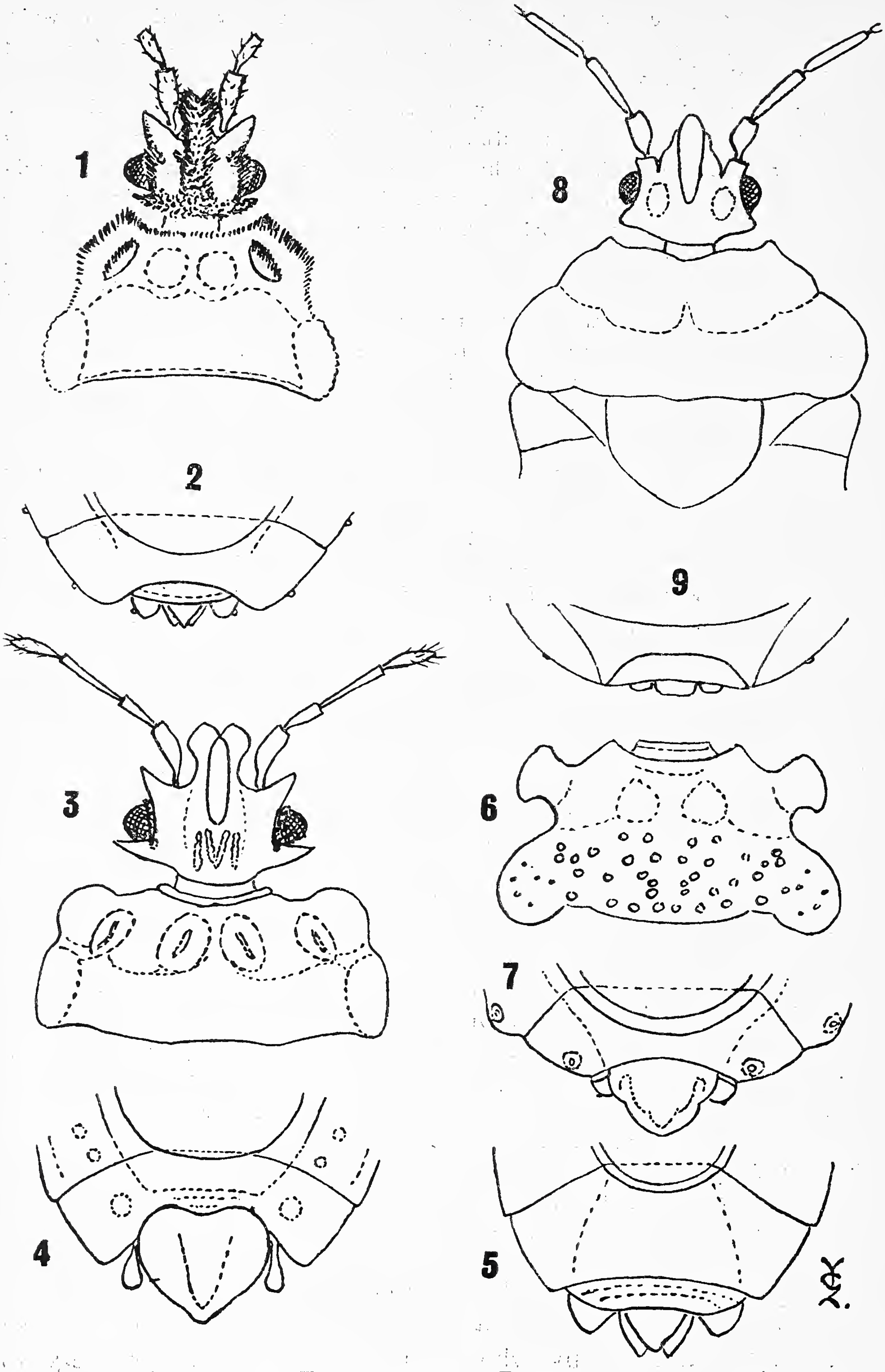
ABDOMEN. Ovate, longer than wide. Connexivum wide, covered with a whitish incrustation; all segments clearly separated from each other, and from midlateral area; every connexivum with two, round, callous spots surrounded with very short, erect, incrustated bristles, looking as granules. PE-angles (postero-exterior) not salient; PE-VII widely rounded; posterior border of segment VII in the females widely cut out; paratergites (lobes) of VIII are rounded, almost reaching the tip of IX, the latter is also rounded.

Pro-, meso-, and metasternum glabrous; mesosternum slightly depressed in the middle. Propleura on the hind lobe with rather long, erect, incrustated bristles; meso- and metapleura, with sparse, granulation-like short, incrustated bristles, and roughly rugose. Scent gland openings small, triangular. Venter roughly punctured; posterior borders of sterna III to V straight, that of VI roundly cut out in the middle; genital plates rather big, rugose, and granulate. Spiracles II to IV ventral, placed far from the border; those of V to VIII lateral and visible from above.

LEGS. Unarmed, but femora and tibiae with setigerous granulation; trochanters relatively very long and naked; claws with arolia.

Genotype: *Halaszfya ovata,* new species

It is a pleasure to dedicate this curious genus to Dr. Eva Halaszfy, Budapest, by whose courtesy I had the privilege to study the very rich material of Aradidae in the collections of the Hungarian National Museum, Budapest.



EXPLANATION OF PLATE.

FIG. 1. *Halaszfya ovata* n.g., n.sp., female, head and pronotum.
FIG. 2. *Halaszfya ovata* n.g., n.sp., female, the tip of abdomen.

Halaszfya ovata, new species

Figs. 1–2.

FEMALE. Testaceous, but the head, fore lobe of the pronotum, and connexivum on both sides, are covered with whitish incrustation, and are lighter. Membrane brown.

BIOMETRICAL MEASURES: head 20:24; antennae 11:7½:—:— (two segments are lacking); pronotum 25:(40):50; scutellum 20:27; abdomen 82:66. First figures indicate length, second width; figures in parenthesis indicate the width of the fore lobe of the pronotum.

FEMALE. Total length 5.13 mm.; width of the pronotum 1.67 mm.; width of the abdomen 2.2 mm.

Holotype: female, Bello Horizonte, Minas Gerais, Brazil—O. Monte coll.; deposited in the collection of the author.

Halaszfya elongata, new species

FEMALE. Closely allied to the previous species, but a little smaller, and particularly narrower. The head almost as long as wide through the eyes (22:23); antennae 10:7½:10:9; pronotum 25:(40):47; scutellum 20:26; abdomen 76:59.

On the fore lobe of the pronotum, at the fore border of the callous spots, are placed two (1 + 1) strong, long erect setae, which are without incrustation, and twice as long as incrustated bristles, placed near them; on the outer carinae are placed six (3 + 3) similar setae. These setae are lacking in *H. ovata* new species.

Apical angle of the corium is sharper, angular; fringe of incrustated bristles on the veins relatively higher. Lobes of VIII are angular, rounded in *H. ovata*. Spiracles II to IV ventral, placed far from the border, but those of V are ventro-lateral, and not visible from above (ventro-lateral, but slightly visible in *H. ovata*).

COLOR. As in *H. ovata.*

Holotype: female, Peru; deposited in the Hungarian National Museum, Budapest.

Genus *Pictinus* Stål, 1873

Pictinus fictus Kormilev, 1959

Pictinus fictus Kormilev, 1959. Rev. Soc. Urug. Ent.; 3:29.

FIG. 3. *Mezira minor* n.sp., male, head and pronotum.
FIG. 4. *Mezira minor* n.sp., male, the tip of abdomen.
FIG. 5. *Mezira minor* n.sp., female, the tip of abdomen.
FIG. 6. *Aphleboderrhis alata* n.sp., male, pronotum.
FIG. 7. *Aphleboderrhis alata* n.sp., male, the tip of abdomen.
FIG. 8. *Aneurus bolivianus* n.sp., female, head, pronotum, and scutellum.
FIG. 9. *Aneurus bolivianus* n.sp., female, the tip of abdomen.

This species was based only on the male, now I am able to give a brief description of a female.

FEMALE. Similar to the male but much bigger; abdomen is wider, with more convex borders. Stridulation apparatus present also in the female.

BIOMETRICAL MEASURES: head 19:23½; antennae 8:6½:7½:10; pronotum 21:(33):43; scutellum 14:23; abdomen 56:55 (across segment IV).

COLOR: head, pronotum, and scutellum, dark piceous to black; hemelytra pale brown with reddish brown veins; membrane dark brown with whitish base; connexivum reddish brown with outer borders piceous, and posterior borders pale brown; tibiae brown with wide pale brown basal ring; tarsi testaceous.

FEMALE. Total length 3.75 mm.; width of the pronotum 1.5 mm.; width of the abdomen 1.9 mm.

Allotype: female, Nova Teutonia, S. Catarina, Brazil—F. Plaumann coll.—VII—1959; deposited in the collection of the author.

Genus *Notapictinus* Usinger & Matsuda, 1959

Notapictinus paramaculatus, new species

MALE. Allied to *Notapictinus maculatus* (Kormilev), 1959, but the head is relatively longer (male—21:22, female—23:24); antennae also relatively longer, more than twice as long as the head wide through the eyes (53:22), less than twice as long in *N. maculatus* (39:21½); proportions of the antennal segments (1–4) are: male—12:10:19:12, female—13:10:21:12½; pronotum is differently shaped: the antero-lateral angles are almost rectangular, with a slightly obtuse tip; measures of the pronotum: male-27:(36):48, female—31:(43):58; scutellum: male—15:25, female—20:30; abdomen: male—71:59 (across IV), female—82:70. Paratergites of the female (lobes of VIII) are relatively shorter, and not so sharply pointed.

COLOR. Lighter: light ferrugineous on the head, pronotum, and scutellum; yellow and ferrugineous on the connexivum; membrane white, slightly infuscate in the middle.

SPIRACLES: II to V ventral; VI sublateral, barely visible from above; VII and VIII lateral and visible.

TOTAL LENGTH: male—4.57, female—5.3 mm.; width of the pronotum: male—1.6, female—1.93 mm.; width of the abdomen: male 1.99, female—2.33 mm.

Holotype: male, Chapada, Brazil, Acc. No. 2966; deposited in the U.S. National Museum, Washington, D.C.

Allotype: female, collected with the male; in the same museum.

Genus *Mezira* Amyot & Serville, 1843

Mezira minor, new species

Figs. 3–5

MALE. Very similar to *Mezira argentinensis* Kormilev, 1953, but smaller

and narrower; antennae relatively longer, ratio between the length of the antennae and the width of the head through the eyes being 38:28, whereas in *M. argentinensis* it is 38½:31½. The color is lighter. Other characters as in *M. argentinensis.*

BIOMETRICAL MEASURES: head: male—25:28, female—25:29; the proportions of the antennal segments (1–4) are: male—10:7:11:10, female—10:7:12:8; pronotum: male—23:(45):52, female—25:(45):52½; scutellum: male—20:25, female—22:25; abdomen: male—76:59, female—81:58.

TOTAL LENGTH: male—4.9, female—5.16 mm.; width of the pronotum: male—1.73, female—1.75 mm.; width of the abdomen: male—1.96, female—1.93 mm.

Holotype: male, Haquaquecetaba, Brazil—H. L. Parker coll. XII—1941—I. 1942; deposited in the Drake collection, U.S. National Museum, Washington, D.C.

Allotype: female, collected with the holotype; in the same collection.

Paratypes: female, collected with the holo- and allotype, and a male collected in Montevideo, Uruguay—H. L. Parker, II. 2. 1942; in the collection of the author.

I would consider this species only as a subspecies of *M. argentinensis,* but the finding of another male in Uruguay makes it impossible to consider it as a geographical subspecies.

Mezira cubana, new species

FEMALE. Elongately ovate. This species stays rather apart from all other North and Central American species of the genus *Mezira* A.S. It has no closer allies among South American species either.

HEAD. Almost as long as wide through the eyes (23:22); anterior process long, with parallel sides, anteriorly deeply cleft, jugae being much longer than the tylus, dentiform, and declivous, similar to the tusks of a *Dynotherium,* reaching to ¾ of the first antennal segment. Antenniferous tubercles dentiform, acute, and divergent, reach to ¼ of the first antennal segment. Eyes large, exerted, semiglobose; postocular tubercles dentiform, acute, do not reach the outer border of the eyes; infraocular carinae practically lacking; vertex convex, finely granulate, as other parts of the head, but without characteristic, rough, granules, regularly forming "V"-shaped figure in other species. Rostrum short, does not reach the hind margin of the rostral groove. Antennae slender, and short, less than twice as long as the head (41:23); the first segment narrow, fusiform; the 2d subcylindrical, the 3d cylindrical, the fourth pyriform; proportions (1–4) are: 11:9:13:8.

PRONOTUM. Flat, rather short (20:43); its fore lobe is much narrower than the hind lobe (32:43); collum slender; antero-lateral angles rounded, and slightly expanded, reaching the fore border of the collum; lateral borders of the hind lobe parallel between themselves, convergent anteriorly;

lateral notch forms an obtuse angle. Fore disc with four (2+2) rather obliterated ridges, sparely granulate around the latter, and along the fore border. Hind lobe rather flat, with sparse granulation on the fore half. Hind border slightly cut out in the middle.

SCUTELLUM. Shorter than wide at the base (20:24); lateral borders straight, and rimmed; median carina thin, and rather low; disc granulate on the hind ⅔ds.

HEMELYTRA. Reach to the fore border of tergum VII; baso-lateral borders of the corium slightly reflexed; apical angle of the same rounded; apical border convex exteriorly, straight interiorly.

ABDOMEN. Much longer than wide (77:54), laterally slightly convex; connexivum very finely granulate; PE-angles not protruding; PE-VII rounded; paratergites (lobes of VIII) long, and rounded, reach to the middle of the long IX; the latter slightly notched at the tip. Spiracles ventral from II to VII, placed far from the border; lateral and visible from above on VIII.

COLOR. Testaceous; antennae ferrugineous; sternum, and venter, yellow-brown to orange, with exception of the genital, and subgenital plates.

FEMALE. Total length 7.2 mm.; width of the pronotum 2.15 mm.; width of the abdomen 2.7 mm.

Holotype: female, Cayamas, Cuba—E. A. Schwarz coll. 10.5; deposited in the U.S. National Museum, Washington, D.C.

Genus *Aphleboderrhis* Stål, 1860

Aphleboderrhis alata, new species

Figs. 6–7.

MALE. Closely allied to *A. comata* Champion, 1898, but differs from it by the different proportions of the antennal segments, the 3d segment being as long as the first, where as in *A. comata* it is distinctly longer; by the different shape of the fore lobe of the pronotum, which is produced laterally in the shape of obliquely elevated "wings," and not in the shape of inflated "hemispheres," as is the case in *A. comata*; by the PE-angles of connexiva VI and VII, in the males, with high, erect, apically rounded, tubercles, particularly high on the PE-VII; and by relatively shorter hairs on the head, pronotum, connexivum, antennae, and legs. Other characters as in *A. comata*. Spiracles from II to VII ventral, placed far from the border, those of the lobes (VIII) terminal.

BIOMETRICAL MEASURES: head 23:28; antennae 23:13:23:— (the 4th is lacking); pronotum 32:(56):62; scutellum 22:32; abdomen 85:71.

COLOR: dark brown to piceous.

MALE. Total length 5.03 mm; width of the pronotum 2.07 mm.; width of the abdomen 2.37 mm.

Holotype: male, Santarem Brazil, Acc. No. 2966; deposited in the U.S. National Museum, Washington, D.C.

Subfamily ANEURINAE Douglas & Scott, 1865

Genus *Aneurus* Curtis, 1825

Aneurus bolivianus, new species

Figs. 8–9.

FEMALE. Elongately ovate, flat, shiny.

HEAD. As long as wide through the eyes (15:15); anterior process tapering, anteriorly rounded, scarcely produced beyond the tip of the first antennal segment; antenniferous tubercles short, truncate; antennae slender; the first segment stout, cylindrical; the 2d and 3d slightly tapering toward the base, covered with whitish bristles; the proportions (1–4) are: 5:7:7:—(the 4th lacking); eyes moderately prominent; postocular tubercles angularly rounded, rather large, but not produced beyond the outer margin of the eyes; vertex with two (1+1) ovate, infraocular, callous spots; between, and behind them transversely rugose. Rostrum short, does not reach the hind margin of the rostral groove, the latter is wide and shallow, transversely striate.

PRONOTUM. Shorter than wide across the humeri (16:36); fore lobe much narrower than the hind lobe (25:36); collum indistinct; fore border emarginate; antero-lateral angles produced forward as small tubercles; lateral borders of the fore lobe slightly, those of the hind lobe strongly, rounded; interlobal notch distinct; interlobal depression feebly marked. Fore disc with a short median furrow, not reaching the anterior border of the lobe; laterad of it with four (2+2) obliterated elevations. Hind disc transversely rugose in the middle; hind border subtruncate.

SCUTELLUM. Shorter than wide at the base (12½:20); borders parallel apically rounded, and finely rimmed.

HEMELYTRA. Reach to the middle of tergum VII; corium very short, obliquely truncate, its outer angle reaches to the middle of the scutellum.

ABDOMEN. Ovate; its maximal width across segment IV; connexivum VII almost touches the segment VIII; paratergites (lobes of VIII) very short, rounded, reach to the middle of IX; the latter posteriorly truncate. Spiracles II, VII, and VIII lateral, and visible from above, others ventral, and not visible.

COLOR. Reddish brown, membrane darker; rostrum, sternum, trochanters, and tarsi, yellow brown.

FEMALE. Total length 6 mm.; width of the pronotum 1.8 mm.; width of the abdomen 2.5 mm.

Holotype: female, Coroico, Yungas, Bolivia; deposited in the Drake collection, U.S. National Museum, Washington, D.C.

Paratype: one female, collected with the holotype; deposited in the collection of the author.

Aneurus bolivianus new species is allied to *A. subdipterus* Burmeister, 1835, but differs from it by: more elongate body, more robust antennae, antero-lateral angles of the pronotum

produced forward as small tubercles, more rounded scutellum, not subtriangular as in *A. subdipterus*, etc.

Aneurus barberi, new species

FEMALE. Closely allied to *A. minutus* Bergroth, 1886, differing from it by: the head is relatively longer, distinctly longer than wide through the eyes; anterior process also relatively longer, slightly produced beyond the tip of the first antennal segment (only reaching in *A. minutus*); antennae relatively longer and stouter, the 2d segment being slightly shorter than the first, or the 3d; pronotum and scutellum are relatively wider, particularly the latter is relatively shorter and wider; abdomen is more elongate, shorter and narrower, the outer borders of connexivum more finely granulate; paratergites of the female (lobes of VIII) reaching the tip of the IX (almost reaching in *A. minutus*). Spiracles in both species have the same distribution: III to V ventral, II, VI and VII lateral and visible from above, VIII terminal.

BIOMETRICAL MEASURES: head 35:33; antennae 10:9:10:22; pronotum 27:(49):67; scutellum 27:48; abdomen 112:87.

COLOR: yellow brown to brown, membrane dark brown.

FEMALE. Total length 3.4 mm.; width of the pronotum 1.11 mm.; width of the abdomen 1.45 mm.

Holotype: female, St. Lucia, B.W.I.—Quilesse—R. G. Fennah coll. 2.22.41; deposited in the U.S. National Museum. Determined by H. G. Barber as *Aneurus* sp.?

This species is dedicated to the memory of the late Mr. H. G. Barber, an eminent American hemipterologist, with whom I was in correspondence during many years. His recent death was a great loss to the American hemipterology as the whole.

Aneurus fritzi, new species

MALE. Elongately ovate, flat, shiny.

HEAD. Slightly shorter than wide through the eyes (male—21:23, female—23:24); anterior process stout, but short, anteriorly rounded, jugae being slightly shorter than the tylus, reaches to the tip of the first antennal segment; antenniferous tubercles short and blunt; eyes moderately large, semiglobose; postocular tubercles angular, apically rounded, and finely granulate, reaching, or almost reaching, to the outer border of the eyes; lateral shelves with two (1 + 1) ovate, callous spots; postocular part of the head roughly, transversely rugose. Antennae long, more than twice as long as the head (male—46:21, female—49½:23). The first segment ovate, the 2d fusiform, the 3d tapering toward the base, the 4th elongately fusiform, all covered with fine bristles. Proportions of the antennal segments (1–4) are: male—7:8:10:21, female—7½:9:11:22). Rostrum very short, by far does not reach the base of the head.

PRONOTUM. Less than half as long as wide across the humeri (male—

22:(37):53, female—22:(40):55); collum obsolete; fore border cut out in the middle; antero-lateral angles regularly rounded; fore disc with four (2+2) almost obliterated (inner ones), or obliterated (outer ones), callous spots, and with an "X"-shaped median sulcus between the former; outside the callous spots finely granulate; interlobal depression broad, and transversely rugose. Lateral borders of the hind lobe rounded, finely rimmed, and convergent anteriorly; hind border slightly cut out in the middle; hind disc with two (1+1) slightly elevated, transverse, callous spots, longitudinally striate laterad of the latter.

SCUTELLUM. Almost semicircular, shorter than wide at the base (male—20:32, female—21½:36); in the middle of the disc, near the base, with a callous spot, and concentrically striate around the latter.

HEMELYTRA. Reach to the middle of tergum VII in both sexes; corium relatively long, its postero-exterior angle reaches to the tip of the scutellum; the baso-lateral border of the corium is narrowly rimmed, and slightly reflexed.

ABDOMEN. Ovate, much longer than wide (male—107:73, female—112:80). Connexivum wide, shiny; every segment but II with two callous spots; tergum VII triangularly produced laterally on each side, reaching to the outer border of the abdomen, and separating connexivum VII from paratergites in the male, and from tergum VIII in the female respectively. Hypopygium of the male is big, produced backward, and apically rounded; paratergites long, flat, apically dilated and truncate, reaching to ¾ of the hypopygium. In the female paratergites are very short, rounded, reaching to the tip of the very short segment IX. Spiracles III to VI ventral and not visible from above, II and VII internal and visible, VIII terminal.

COLOR. Dark piceous; femora and tibiae slightly lighter; rostrum and tarsi yellow brown; connexivum and tergum chestnut brown; female with two (1+1) dark spots on tergum VII.

TOTAL LENGTH: male—5.73, female 6.00 mm.; width of the pronotum: male—1.77, female—1.83 mm.; width of the abdomen: male—2.47, female—2.67 mm.

Holotype: male, Sihuenkas, Yungas de Totora, Bolivia—M. Fritz coll. XI.56; deposited in the collection of the author.

Allotype: female, collected with the holotype; in the same collection.

Paratypes: 1 male and 7 females, collected with the holo- and allotypes; in the same collection.

It is a pleasure to dedicate this species to its collector, and my friend, Mr. Manfredo Fritz, from Buenos Aires.

Aneurus fritzi new species is allied to *A. burmeisteri* Bergroth, 1886, but differs from it by: bigger size; relatively longer antennae, the 4th segment being three times as long as the 2d; relatively wider scutellum, etc.

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BOOK REVIEW

Journey Into Summer by Edwin Way Teale. Dodd, Mead & Company, N.Y., 366 pages, 53 photographic illustrations. Price $5.95. Published October 1960.

The completion of a new book by Edwin Way Teale is always a notable event. It seems certain that the publication of his *Journey Into Summer* has been anticipated with unusual eagerness, for the appearance of the first two volumes in the "Seasons" series gave sure promise of more good things to come. There will be no disappointment on this score, although the Society may admit to a touch of jealousy that the ever-broadening interests of its best-known member have caused an ecdysis which has transformed him from an entomologist into a naturalist of unusual distinction. In point of fact, insects have a rather small part in *Journey Into Summer,* although when they appear they are treated in Mr. Teale's inimitable fashion. His description of the mayfly swarms around Kelleys Island will be recognized as letter-perfect by anyone who has witnessed the prodigious flights that occur in the Great Lakes region.

But mainly Mr. Teale has occupied himself with other things and the scope of his interest is astonishing. To his customary charming accounts of the doings of animals he has added equally attractive discussions of the zonation of plants, the mechanics of meteors, the characteristics of dust storms and the behavior of sand dunes. Mr. Teale's concern for accuracy is proverbial but his accurate presentation of facts is not enough to account for the popularity of his writings. Nor is it the admirable style in which these facts are presented. The world is full of able reporters whose work is both accurate and highly literate, but few of them are able to rouse in their readers a pleasant glow of response. This is Teale's great gift and he has used it well in *Journey Into Summer.* To read this book is a heart-warming experience, particularly so if one has travelled the roads which Teale took in his journey.

Teale's writings show his personality so clearly that it must have taken considerable courage on the part of Edward H. Dodd, Jr., to prepare the brief biographical sketch, *Of Nature, Time*

and Teale, which Dodd, Mead & Co. published last spring. For the ardent Teale enthusiast is apt to take the view that no one can explain Teale better than he has explained himself. Nevertheless, this slender volume of sixty-three pages contains many revealing touches. The section which deals with Mr. Teale's meticulous writing techniques is especially interesting. There are those who believe that when a gifted writer picks up a pen, felicitous phrases immediately flow from it. Such people will be shocked to learn of Teale's prolonged, systematic and arduous labors over his books. They may even conclude that their idol has feet of clay. The perceptive reader will take a sounder view. He will realize why Teale has reached the unique position that he occupies, for such a fortunate fusion of patience, pertinacity and literary acumen is rare indeed.—W.S.C.

BOOK REVIEW

Wonder Workers of the Insect World by Hiram J. Herbert, 160 pages, 16 plates of illustrations, E. P. Dutton & Co., Inc., New York. Published September 1960. Price $3.00.

The volume carries a foreword by Dr. Lucy Clausen. It consists of fifteen chapters, a ''bibliography'' and an index. The subject matter deals with both insects and spiders with the former predominating. Three of the chapters are devoted to the habits of wasps. Others deal with the habits of dragonflies, fireflies, mantids, grasshoppers, butterflies, moths, antlions and mosquitoes.

Mr. Herbert's book adds another title to the growing list of volumes which attempt to popularize insect habits. The mention of such a book is usually enough to make the trained entomologist groan, for he knows before he opens the cover what he will find in it. The author will be coy, both with his readers and with the insects he is introducing to them. In Mr. Herbert's volume this is carried to the extreme of having the insect speak to the reader. There is certain to be overdramatization, often accompanied by needlessly lurid prose. The attack of a pompilid wasp on a spider is sufficiently savage to need no literary embellishment, yet Mr. Herbert is not content to report the facts, the wasp must scream during the attack. Perhaps Mr. Herbert has confused the wasp with the reader in this case, for the reader certainly has good justification for screaming.

One of the most disturbing features of Mr. Herbert's work is his lack of consistency in the terminology applied to the stages of insect metamorphosis. Much of the time he seems to be uncertain of whether he is dealing with a larva, a nymph or a pupa. We cannot suppose that Mr. Herbert has followed the obsolete practice of applying the term ''nymph'' to the pupal stage; he knows the term ''pupa'' and sometimes uses it correctly. But at other times he fails to do so with harrowing results. Thus in his chapter on Vespa (page 69) Mr. Herbert states that in a nest which he had been watching ''the larvae began cutting their way out of their nymphal chambers.'' This was reported as a first hand observation, a fact which makes Mr. Herbert's other pur-

ported observations highly suspect. For if Mr. Herbert had observed the emergence of the young wasps he would have known that the adult emerges from the pupal cell. Since he correctly records (page 20) that the larva of Pompilus pupates and later emerges as an adult, his confused account of Vespa becomes even more inexplicable. Nevertheless, there is a perverse skill in it, for Mr. Herbert has achieved the unenviable distinction of including three major errors in a statement nine words in length.

It is unfortunate that someone with entomological training was not secured to help the illustrator, Robert Gartland. Mr. Gartland evidently has the knack of instilling life into his drawings. But it is equally evident that he knows nothing about insects and the structures which he portrays are often so grossly inaccurate that one loses sight of the liveliness of his drawings. There has been overdramatization here also, for no other interpretation can be put on the illustration opposite page 130, where a colossal, one-eyed mosquito, whose wings are attached to the metathorax, gazes from what appears to be the flight deck of an aircraft carrier at its prospective victim.

At a time when it has been clearly shown that the general public accepts and enjoys authoritative scientific articles, when these are clearly written and presented without condescension or coyness, it is difficult to see why Mr. Herbert's book should have been considered for publication. It is neither original, authoritative nor written in a pleasing literary style. It does not seem too much to ask that both the publishers and the writers of "popular" scientific books wake up to the fact that the general reader is not a feeble-minded idiot.—W.S.C.

THREE NEW NEW WORLD HALYINE PENTATOMIDS (HEMIPTERA; PENTATOMIDAE)

BY HERBERT RUCKES

RESEARCH ASSOCIATE, THE DEPARTMENT OF INSECTS AND SPIDERS, THE AMERICAN MUSEUM OF NATURAL HISTORY AND PROFESSOR EMERITUS, THE CITY COLLEGE OF NEW YORK

The following three new species of pentatomids have been culled from the collections of undetermined material in the United States National Museum and the American Museum of Natural History. One represents a new genus as well as a new species; the other two are new examples of *Brochymena,* which now bring the total number of species in that genus to thirty.

The various numerical ratios given in the descriptions are dimensions measured through a binocular microscope, with the use of a $\times 2$ objective and a $\times 9$ ocular fitted with a micrometer scale divided into 200 linear units (at this magnification equivalent to 5.0 mm.); they are not in terms of millimeters except as specified for holotypes and allotypes.

Subfamily PENTATOMINAE Stål

Tribe Halyini Stål

Genus *Brochymena* Amyot and Serville

Brochymena enigmatica, new species

FORM. Oval, ochraceous above with more or less uniform and densely distributed fuscous punctures.

HEAD. Slightly longer than the medial pronotal length (150×132) and almost twice as long as wide between the eyes (150×78); vertex distinctly convex; anteocular margins thickish and gradually converging to an acute, equilateral triangular apex; juga equally as long as the tylus, subpical teeth very acute, their adjacent sinuses likewise acute. Antennae long and slender, fuscous to piceous, the segments very narrowly pale only at their bases; segmental ratios: 40/60/80/100/100, i.e., segments I to IV progressively elongating by a regular increment, segments IV and V equal and longest.

PRONOTAL SURFACE. Somewhat feebly undulant, with six larger, irregular, laevigate ochraceous callosities in the vicinity of the cicatrices; anterolateral areas fuscous, feebly tumid, their margins provided with four well-spaced, acute conical denticles; antehumeral sinuses pronounced, the humeri piceous, very strongly produced, somewhat stump-shaped, their lateral extension greater than their anterior-posterior diameter, their apical teeth acute, not

strongly divergent. Scutellum about one-fourth longer than wide at the base (230 × 180); basal third mildly convex and weakly elevated, disc more laevigate there than on the remaining portions; basal angles with a small piceous pit or fovea adjacent to a small ochraceous callus. Hemelytra very densely and somewhat congestedly punctured; vermiculations on the membrane ferruginous brown and very strongly defined. Connexivum well exposed, distinctly alternated black and orange or ochraceous, the piceous areas forming broad bands on each side of the segmental sutures; segmental apical angles rectilinear and weakly produced.

VENTRAL SURFACE. Essentially ochraceous, thickly covered with a farinaceous bloom which obscures the color design. Rostrum reaching the base of the fourth abdominal sternite. Abdominal venter shallowly furrowed through the fourth segment; the lateral margins of each segment provided with well-defined castaneous lunes as is common in many allied species. Ostiole of metasternal gland inconspicuous, and devoid of an auricle or canal. Legs flavescent, badly damaged in this unique specimen; femora with broad apical and subapical fuscous annuli; tibiae with subbasal and subapical fuscous or castaneous annuli, the broad pale area between the annuli provided with a small, central, fuscous or castaneous square blotch; anterior tibiae feebly clavate apically; proximal and distal segments of the tarsi castaneous, the middle one concolorous yellow.

MALE. Genital segment somewhat depressed, cup-shaped, transversely elliptical; widely open posteriorly, the contents totally visible; apical margin thin and weakly reflected, the ventral margin feebly trisinuate, the superior margin provided with a thin brush of declivent golden hairs; parameres stout, their heads subpyramidal or wedge-shaped, their inner surfaces divergent from the base, roundly triangular in outline, the outer surfaces provided with a blunt forward projecting lobe that reaches the inner wall of the cup; ventral margins of the heads thin, and slightly overhanging the inferior (ventral) margin of the segment; proctiger pyriform in outline, its crest obtuse.

Described from one specimen.

Holotype: Male: 16.0 mm. long; 8.75 mm. wide across the tips of the humeral lobes. Vera Cruz, Mexico, 1896. H. Heyde, collector. From the collection of C. F. Baker. Deposited in the United States National Museum.

This new species belongs to that subgeneric complex of *Brochymena* which includes forms with quadrangular humeri and in which the metasternal ostiole is devoid of an auricle or lateral canal, the male genital capsule is widely open posteriorly so that the contents are totally visible and the head of the claspers overhangs the ventral lip of the genital segment. No other species of *Brochymena* known to me has parameres like those found in this species. There is no doubt that it belongs close to such other species as *arborea, haedula, aculeata, poeyi,* etc., but the differences

exhibited in the head shape, antennal proportions, the conical denticles on the anterolateral margin of the pronotum, as well as the form of the parameres however, set it aside. The quadrangular humeri are most like those in *poeyi,* while the weakly clavate foretibiae closely resemble those found in *aculeata.*

Brochymena exardentia, new species

Narrowly oval, semiglossy, brownish gray, punctures fine, dense, regularly distributed, more or less uniform in size, only a few coarser ones on the pronotum and scutellum; somewhat depressed above, moderately convex beneath.

HEAD. As long as the median length of the pronotum (150 x 150) and twice as long as wide between the eyes (150 x 75); juga subequal to the tylus; subapical teeth small, acute and meeting the margins of the juga at right angles; predenticular portion of the head triangular, half as long as wide between the teeth, the apex acute; anteocular margins up to the subapical teeth feebly concave and subparallel; punctures dense, the impunctate areas forming a fine, irregular, ochraceous reticulum. Antennae long, stoutish, reaching to about the middle of the scutellum; basal three segments reddish fuscous, terminal two segments almost piceous; segmental ratios: 40/80/80/80/73, i.e., segments II, III, IV equal, segment V shorter.

PRONOTUM. Two and one-third times as wide as long medially (350 x 150); humeri not at all prominent, acutely rounded apically, with a few reduced denticles on their anterior margins; antehumeral sinus shallow, inconspicuous, marginal teeth six to nine in number, small, acute, triangular to subconical; surface moderately undulant, the majority of the punctures small, dense, and rather regularly distributed; some sparsely distributed, coarser, piceous punctures occurring in two widely separated irregular patches across the posterior portion of the pronotum, some of the punctures coalescing, the patches about as far apart as each is distant from the adjacent humerus; the anterior half of the disc provided with a vague median ochraceous linea. Scutellum long triangular, the lateral margins feebly sinuate at the point where the frenum ends, the postfrenal margins rapidly converging to a narrowly rounded but not acute apex; basal angles deeply foveolate, piceous, followed posteriorly by a short submarginal patch of enlarged and coalescent piceous punctures, a few (8 to 10) other coarse punctures scattered irregularly over the disc; most punctures small, uniform in size and regularly distributed; a large basal, somewhat flat-topped, triangular area and a posteriorly continued obtuse ridge on the disc weakly elevated, the median line ochraceous. Hemelytra very densely, finely and regularly punctured, without evidence of any coarser punctures; a small pale, impunctate, discal spot present; veins and vermiculations of the membrane rich ochraceous brown, tending to fade centrally. Connexivum well exposed, vaguely differentially colored, almost concolorous dark reddish-brown-gray, densely punctured, only the elevated margins of the segmental sutures laevigate ochraceous; apical segmental angles rectilinear and not at all produced.

VENTER. Entirely infuscated, without the benefit of piceous lunate markings commonly found near the lateral margins of the abdominal segments in allied species; punctures dense, fine and covering nearly the entire ventral surface. Rostrum long, reaching the middle of the fourth abdominal sternite; abdomen deeply furrowed through the fifth segment; segmental ratios: 60/120/110/80, i.e., segment II longer than segment III. Auricle of the metasternal ostiole small, thin, spatulate, well elevated and without a spiral twist to it. Femora reddish, conspurcated, with an incomplete subapical pale annulus; tibiae dark reddish brown with a broad flavescent annulus at the middle, provided with a centrally placed, vague dark spot on the middle and hind tibae; tarsi concolorous fuscous.

MALE. Genital segment subglobular, smallish, totally fuscous to piceous; lateral apical lobes obtuse and somewhat retrorsely produced, the apical margin of the segment (ventral aspect) broadly U-shaped; heads of the claspers small, half-moon shaped in ectal or ental aspect, wedge shaped from the posterior or anterior aspect; proctiger oblong, feebly tumid at its crest.

Described from two specimens.

Holotype: Male: 16.0 mm. long; 8.75 mm. wide across the humeral angles; Madera Canyon, Davis Mountains, Texas. July 20, 1950. Deposited in the American Museum of Natural History.

Paratype: Male: Some data as above, August 11, 1958, W. F. Barr, collector. Deposited in the University of Idaho, Moscow, Idaho.

The shape of the head, the small, fine denticles on the anterolateral pronotal margins and, most importantly, the form of the male genital segment and its wedge-shaped, semilunate claspers indicate very close affinity between this species and *Brochymena cariosa, Brochymena lineata,* and *Brochymena parva,* probably closest to *Brochymena lineata.* The distinguishing characteristics are primarily found in the scarcity of coarse punctures on the body, the more or less concolorous connexivum, the dirty ashy-gray color, the long rostrum, the heavily infuscated venter, and the subdepressed form.

Orbatina, new genus

Obovate, moderate to large, 14.5 to 17.0 mm. long; mildly convex above, very strongly so beneath, especially the abdomen; head and anterior half of pronotum very weakly declivent; densely but irregularly punctured.

HEAD. (Excluding eyes) subelliptical, about three-fourths of the medial pronotal length, margins very gently convergent apically and very shallowly sinuate at the middle; juga narrowly rounded apically, subequal to the tylus or very slightly longer, in which case there is a small emargination there; eyes subglobular, protuberant and extending the anterior width of the

pronotum; ocelli about three times as far apart as distant from the eyes and lying in line with the posterior margins of them; antennal tubercles stout, unadorned and totally visible from above; antennae mutilated, segment I exceeding the apex of the head.

PRONOTUM. Subhexagonal in outline, somewhat more than twice as wide across the humeral angles as long medially, the posterior and posterolateral margins very broadly and obtusely confluent so that the posterior angles are obsolete; anterior margin shallowly excavated centrally to receive the head, then truncate behind the eyes; anterolateral margins thinly subcalloused, shallowly and broadly concave near the middle, each margin terminating anteriorly in a denticle or minute lobe behind each eye; humeri prominent but not strongly produced, their apical angles acutely rounded; disc shallowly impressed behind the central portion of the anterior margin, otherwise only feebly undulant. Scutellum longer than wide at the base, the frenum ending at or just behind the middle, the postfrenal portion moderately broad, slightly more than half as wide as the width at the base, its margins subparallel, the apex subtriangularly rounded, reaching onto the fifth abdominal tergite, the apical and subapical margins sometimes narrowly and feebly reflexed. Connexivum narrowly exposed, segmental angles not strongly produced.

ROSTRUM. Reaching the fourth abdominal sternite, segment I exceeding the bucculae, segments II and III subequal. Abdomen quite convex, shallowly and broadly furrowed to the fifth sternite, the trichobothria transversely placed and lying completely ectad of the line of spiracles. Mesosternum and metasternum provided with a very thin, low, longitudinal carina, the metasternum not at all elevated. Mesocoxae and metacoxae mutually equidistant. Metasternal orifice provided with a long stout, digitiform, elevated lobe or auricle (without a canal) which ends abruptly near the middle of the supporting plate; evaporatorium rugulose and elevated as a thin disc. Legs proportionately slender, the femora more or less uniform in diameter and only slightly stouter than the tibiae; the tibiae broadly and shallowly sulcate on their upper surfaces; dorsal surface of the terminal segment of the hind tarsi distinctly depressed or concave.

Type species: **Orbatina fuligina**, new genus, new species.

This new genus is apparently related to *Ochlerus* Spinola and, in the phylogeny of the tribe, should be placed near by. However, such great differences occur in the composition of the male and female genitalia that segregation of the two is strongly warranted. The distinguishing characters of *Orbatina* are found in the shape of the head, the slightly prominent humeri, the proportionately long rostrum, and the stouter scutellum with its declivent postfrenal portion.

Orbatina fuligina, new species

Matte above and beneath; sordid tan and fuscous above, producing somewhat of a two-toned sooty appearance, reddish fulvous and fuscous or piceous

beneath; punctures fuscous or darker, densely and irregularly distributed above, more regularly so beneath; setae short, fine and reduced to a minimum.

HEAD. Lightly infuscated, half again as long as wide between the eyes (120 × 80), surface somewhat irregular, punctures piceous, dense and tending to become congested; margins feebly ampliate just before the eyes, then very shallowly sinuate and continued apically by gradually converging to a rounded apex, which is sometimes incised; entire tylus and bases of the juga transversely rugose; vertex flattish and irregularly rugose. Eyes fuscous, ocelli topaz, prominent, about one-third of the diameter of the eye. Antennal tubercles piceous; antennae apparently five-segmented, concolorous dark tan or lightly infuscated (only three segments preserved), segment I exceeding the apex of the head by one-third of the segmental length, segment II slightly shorter than segment I and half as long as segment III. Other features as described for the genus.

PRONOTUM. About two and one-fourth times as wide across the humeral angles as long medially (380 × 170), lightly infuscated except for the areas around the cicatrices which are paler, and the humeral angles, the posterior humeral margins, and the anterior apical lobules which parts are flavescent; surface irregularly transversely rugose, except for the apical area, the rugae most prominent across the center and on the posterior portion of the disc; punctures of two sizes, larger piceous ones somewhat irregularly distributed but densest around the periphery, interspersed with numerous extremely fine ferruginous or light brown ones; anterolateral margins slightly roughened, very shallowly sinuate in an obtuse angulated form near the middle. Scutellum weakly convex at the base but not elevated above the level of the pronotum, somewhat impressed on each side near the basal angles, there piceous and finely punctured; ground color sordid yellowish tan; a broad intramarginal band of fuscous or piceous punctures on each side which become less dense and spread mesally beyond the end of the frenum, leaving a broad median area of the ground color exposed, through the center of which extends a line of wider-spaced fuscous punctures; a large number of finer ferruginous or light brown punctures interspersed with the larger fuscous ones; the apical and subapical margins narrowly fuscous, interrupted at the extreme apex by a flavescent spot (in the female these margins are weakly reflexed); posterior half of postfrenal portion weakly declivent. Hemelytra sordid yellowish tan, the main veins conspicuously pale, the punctures fuscous, finer and denser on the embolium, those on the corium tending to congest into a small dark cluster near the middle; free apical margin of the corium feebly sinuate, the external apical angle acute and barely extending beyond the apex of the scutellum; membrane transparent flavescent, infuscated basally, the veins colorless, numerous and subparallel. Connexivum narrowly exposed, sordid, yellowish tan, the segmental sutures bordered by broad fuscous or piceous patches, the discs coarsely punctured, the apical segmental angles ivory colored, minutely globular and slightly produced.

Under surface of the head piceous except for the juga and a narrow band across the base which areas are impunctate and flavescent; punctures deep

and dense. Thoracic pleura extensively overlain and suffused with fuscous except for the submarginal band on the pronotum which is usually yellowish; punctures deep and dense. Auricle of the metasternal ostiole flavescent, evaporatorium piceous. Abdomen fulvous to reddish fulvous, very densely covered with fine, shallow, fuscous or piceous punctures except submarginally which area is narrowly sordid yellow, and where the segmental sutures are bordered on each side with a fuscous patch. Rostrum medium brown, only the extreme tip piceous; segment I reaching the margin of the prosternum, segment II attaining the mesocoxae, segment III slightly exceeding the metacoxae, the apex of segment IV reaching the anterior margin of the fourth abdominal sternite; segmental ratios: 65/110/110/80, i.e., segments II and III equal. Legs concolorous medium brown, the tibiae and tarsi a little paler.

MALE. Genital segment ovoidal, about half again as long as wide; apical margin (ventral aspect) in the form of a broad and deep U-shaped emargination; lateral apical lobes stout, retorsely produced somewhat, their apices acutely rounded, their inner and outer margins (dorsal aspect) strongly elevated (the inner margin carina-like in form) so that their upper surfaces are deeply concave; parameres vertically lamellate, posteriorly convergent, apically dilating into concave heads, which when seen from the posterior aspect are vertically obpyriform in outline; proctiger very broadly rhomboidal, and so thinly sclerotized as to be almost transparent, taking on the appearance of a partially deflated balloon, only the lateral margins are reinforced. Basal plates of the female genital valves, when taken together, form a broad crescent or lune, the ends of which are obtusely rounded; the inner margin of each plate is slightly elevated so that the two combined form a dual or pseudocarina; the median plate deeply sulcate longitudinally; apical plates contiguous in the midline, their apices not exceeding the posterior margin of the abdomen.

Described from two specimens.

Holotype: Male: 14.5 mm. long; 8.0 mm. wide across the humeral angles. Palmira, Colombia. May 3, 1935. Deposited in the American Museum of Natural History.

Allotype: Female: 17.0 mm. long; 9.5 mm. wide across the humeral angles. Rio Huallaga, Peru. February 29, 1932. H. Bassler, collector. Deposited in the American Museum of Natural History.

Since this is a new species in a new genus there is as yet no known affiliate. The most striking feature of this species lies in the almost membranous condition of the proctiger in the male and in the longitudinally sulcate median plate of the genital valves in the female.

AN ANNOTATED LIST OF THE LYCAENIDAE (LEPIDOPTERA: RHOPALOCERA) OF THE WESTERN HEMISPHERE

BY WILLIAM PHILLIPS COMSTOCK AND EDGAR IRVING HUNTINGTON

[Continued]

iambe Godman, F. D. and O. Salvin, *Thecla*
Type Locality: San Francisco, Costa Rica.
Location of Type: British Museum (Natural History).
Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 86, vol. 3, pl. 57, figs. 28, 29 ♂ (London).
Synonyms: *jambe* Draudt.

ianthe Edwards, William H., *Chrysophanus*
Type Locality: Nevada (♂, ♀).
Location of Type:
Original Description: 1871 (January), Trans. Amer. Ent. Soc., vol. 3, p. 211 (Philadelphia, Pa.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 26, no. 431 (Los Angeles, Calif.). (Places *ianthe* as a synonym of *nivalis* Boisduval.)

icarioides Boisduval, Jean A., *Lycaena*
Type Locality: Mountains of California, June.
Location of Type: United States National Museum?
Original Description: 1852, Ann. Soc. Ent. France, Series 2, vol. 10, p. 297 (Paris).
Additional Reference: Oberthür, Charles, 1913, Etudes de Lepidopterologie Comparee, fasc. 9, pt. 1, p. 41, pl. 237, fig. 1943 ♂ (Rennes).
Synonyms: *daedalus* Behr, *fulla* Edwards, *maricopa* Reakirt, *windi* Gunder syn., *mintha* Edwards, *mincha* Kirby syn., *phileros* Boisduval, *spinimaculata* Gunder .
Subspecies: *montis* Blackmore, *moroensis* Sternitzky, *pembina* Edwards, *ardea* Edwards, *blackmorei* Barnes and McDonnough, *buchholzi* dos Passos, *evius* Boisduval, *helios* Edwards, *helius* (Zool. Record) syn., *lycea* Edwards, *rapahoe* Reakirt, syn., *missionensis* Hovanitz.

ilavia Beutenmüller, William, *Thecla*
Type Locality: Texas.
Location of Type: American Museum of Natural History.
Original Description: 1899 (December), Jour. New York Ent. Soc. vol. 7, p. 254 (New York, N. Y.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 24,

no. 376 (Los Angeles, Calif.). (Places *ilavia* as a subspecies of *autolycus* Edwards.)
Synonyms: *mirabelle* Barnes.

illex Schaus, William, *Thecla*
Type Locality: Colombia.
Location of Type: United States National Museum, no. 5949 ♂.
Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 419 (Washington, D. C.).

imma Prittwitz, O. V., *Thecla*
Type Locality: Corcovado, Rio de Janeiro, Brazil.
Location of Type:
Original Description: 1865, Stettin Ent. Zeit., vol. 26, p. 322 (Stettin).
Synonyms: *innua* (Zool. Record).

immaculata Cockle, J. W., *Thecla iroides* var.
Type Locality: Kaslo, British Columbia, May, 1897.
Location of Type:
Original Description: 1910 (June), Can. Ent., vol. 42, p. 204 (London, Ontario).

immaculata Gunder, Jean D., *Satyrium fuliginosa* tr. f.
Type Locality: McGee's Creek, near Mammoth, Mono County, California, June 20, 1926.
Location of Type: American Museum of Natural History.
Original Description: 1927 (December), Can. Ent., vol. 59, p. 283, pl. A, fig. 6 (Orillia, Ont.).

immaculata Chermock, F. H., *Plebeus lupini* ab.
Type Locality: Gold Lake District, Sierra County, California.
Location of Type: Chermock Collection?
Original Description: 1929, Bull. Brooklyn Ent. Soc., vol. 24, p. 20 (Brooklyn, N. Y.).

immaculata Lathy, Percy I., *Trichonis*
Type Locality: ?
Location of Type: Fournier Collection, Paris.
Original Description: 1930 (June), Trans. Ent. Soc. London, vol. 78, p. 133 (London).
Note: Lathy refers to Hewitson's figure of *theanus*, Illus. of Diurnal Lepidoptera, vol. 2, pl. 29, fig. 2 ♀, as illustrating his new species, saying that the figure is that of a male.

immaculosus Comstock, William P., *Strymon titus* var.
Type Locality: Provo, Utah, July 27, 1909 (collector T. Spalding).
Location of Type: American Museum of Natural History.
Original Description: 1913 (February), Bull. Brooklyn Ent. Soc., vol. 8, no. 3, p. 33, pl. 11, figs. A–H (Brooklyn, N. Y.).

imperialis Cramer, Pierre, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1775, Papillons exotiques des trois parties du monde, vol. 1, p. 120, pl. 76, figs. E, F. (Amsterdam).
Synonyms: *venus* Fabricius.

improba Reed, E. C., *Cupido*
Type Locality: Chile.
Location of Type: Museo Nacional.
Original Description: 1877, Una Monografía de las Mariposas Chilenas, p. 67 (Santiago de Chile).
Additional Reference: Butler, A. G., 1881, Trans. Ent. Soc. London, p. 467 (London). (Places *improba* as a synonym of *adonis* Schiffermüller and Denis which is a Palaearctic species.)

inachus Cramer, Pierre, *Papilio*
Type Locality: "Indes Occidentales."
Location of Type:
Original Description: 1775, Papillons exotiques des trois parties du monde, vol. 1, p. 58, pl. 36, fig. D (Amsterdam).
Additional Reference: Hewitson, W. C., 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 183, vol. 2, pl. 72, figs. 557 ♂, 558, 559 ♀ (London).
Synonyms: *baeton* Sepp.
Subspecies: *carpophora* Hewitson.

inaequalis Tutt, J. W., *Celastrina argiolus* ab.
Type Locality: Brooklyn, New York.
Location of Type:
Original Description: 1908, Nat. Hist. British Lepidoptera, vol. 9, p. 416 (London).
Additional References: Edwards, W. H., 1884, Butterflies of North America, vol. 2, p. 10, pl. 2, fig. 24 Lycaena (Boston, Mass.). McDunnough, J. H., 1938, Check list, pt. 1, p. 29, no. 475 (Los Angeles, Calif.). (Places *inaequalis* as an aberration of *pseudargiolus* Boisduval and LeConte.)

inconspicua Lathy, Percy I., *Thecia*
Type Locality: Petropolis, Brazil, August 28, 1872, 1 ♀.
Location of Type: Fournier Collection.
Original Description: 1930 (June), Trans. Ent. Soc. London, p. 136, pl. 9, fig. 15 ♀ (London).
Note: "This species is closely allied to *basalides* Hübner, but may be distinguished by the absence of spots near the base of the hind wing below."

inconspicua Draudt, Max, *Itylos*
Type Locality: Cuzco, Peru, 3600 meters.
Location of Type:
Original Description: 1921 (January), The Macrolepidoptera of the World, vol. 5, p. 822, pl. 144-m (Stuttgart).

indigo Druce, Hamilton H., *Thecla*
Type Locality: Chapada Campo, Brazil, January.
Location of Type: Godman Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 609 (London).
Additional Reference: Draudt, Max, 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 794 (Stuttgart). (Considers *indigo* a subspecies of *vitruvia* Hewitson.)

ines Edwards, W. H., *Thecla*
Type Locality: Southern Arizona, October.
Location of Type: Pittsburgh, Pennsylvania (Carnegie Museum).
Original Description: 1882 (February), Papilio, vol. 2, p. 25 (New York).
Additional References: Holland, W. J., 1931, The Butterfly Book, 2nd Edition, p. 240, pl. 29, fig. 35 (type) (New York, N. Y.). (This probably fixes the lectotype.) Barnes, William J. and J. H. McDunnough, 1912 (July), Contributions to the Natural History of the Lepidoptera of North America, vol. 1, no. 4, p. 57, pl. 27, figs. 5, 6, 7 (Decatur, Illinois). Stallings, D. B. and J. R. Turner, 1947 (February), Ent. News, vol. 58, p. 39 (Philadelphia, Pa.). (Places *ines* as winter form of *leda* Edwards, therefore a synonym).

infrequens Weeks, A. G., Jr., *Thecla*
Type Locality: Cusilluni, Bolivia, May, 1899. Three specimens, no type selected.
Location of Type: Museum of Comparative Zoology, Cambridge, Massachusetts.
Original Description: 1901, Ent. News, vol. 12, p. 265 (Philadelphia, Pa.).
Additional References: Weeks, A. G., Jr., 1905, Illus. of Diurnal Lepidoptera, p. 37, pl. 6, fig. 3 (Boston, Mass.). Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 88 (New York, N. Y.). (Remark that *infrequens* is probably not a synonym of *bazochii* Godart as stated by Draudt (1920, The Macrolepidoptera of the World, vol. 5, p. 810).

ingae Sepp, Jan, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1848, Surinaamsche Vlinders, vol. 1, p. 41, pl. 17 (Amsterdam).
Additional Reference: Druce, H. H., 1907 (June), Proc. Zool. Soc. London, p. 631 (London). (Makes *ingae* a synonym of *eryx* Cramer.)

innua, Thecla. Misspelling of *imma* Prittwitz
Type Locality:
Location of Type:
Original Description: 1866, Zool, Record, vol. 2, p. 599 (London).

inoa Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Jalapa, Mexico.
Location of Type: British Museum (Natural History).

Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 88, vol. 3, pl. 58, figs. 18, 19 ♂ (London).

inorata Grote, Augustus R. and Coleman T. Robinson, *Thecla*
Type Locality: New York.
Location of Type: American Museum of Natural History.
Original Description: 1868 (January), Trans. Amer. Ent. Soc., vol. 1, p. 323 (Philadelphia, Pa.).
Additional Reference: Barnes, W. J. and J. H. McDunnough, 1916, Contributions to the Natural History of the Lepidoptera of North America, vol. 3, no. 2, p. 104 (Decatur, Illinois). (Indicate that *inorata* is a synonym of *calanus* Auctorum = *falacer* Godart.)

inorata Lathy, Percy I., *Thecla*
Type Locality: Rio Grande do Sul, Brazil.
Location of Type: Fournier Collection, Paris.
Original Description: 1936, Livre jubilaire de M. Eugene-Louis Bouvier, p. 229, pl. 8, fig. 3 (Paris).

insignis Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Chiriquí, Panamá.
Location of Type: Staudinger Collection.
Original Description: 1887 (October), Biologia-Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 99 (London).
Described from a single female. Similar to *schausi*.

instita Druce, Hamilton H., *Thecla*
Type Locality: Chapada Campo, Brazil (January and March).
Location of Type: Godman Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 618 (London).

insulanus Blackmore, E. H., *Plebeius saepiolus*
Type Locality: Victoria, B. C., May 24, 1916.
Location of Type: Canadian National Collection, Ottawa, Canada.
Original Description: 1919 (March), Proc. Ent. Soc. British Columbia, no. 14, p. 8, pl. 1, fig. 7 (Victoria, B. C.).

intermedia Strecker, Herman, *Lycaena lucia* ab. ♀
Type Locality: Virginia.
Location of Type:
Original Description: 1878, Butterflies and Moths of North America, A Complete Synonymical Catalog, p. 95, no. 136 (Reading, Pa.).
Additional Reference: Barnes, W. J. and F. H. Benjamin, 1926 (March), Bull. Southern Calif. Acad. Sci., vol. 25, p. 20 (Los Angeles, Calif.). (List *intermedia* as a female form of *pseudargiolus* Boisduval and LeConte.)

intermedia Barnes, W. J. and J. H. McDunnough, *Philotes battoides*
Type Locality: Shasta County, California, third week in July.
Location of Type: United States National Museum (Barnes Collection).

Original Description: 1917 (March), Contributions to the Natural History of the Lepidoptera of North America, vol. 3, no. 4, p. 214, pl. 16, figs. 4–6 (Decatur, Illinois).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 28, no. 466 (Los Angeles, Calif.). (Places *intermedia* as a subspecies of *glaucon* Edwards.)
Synonyms: *malcolmi* Gunder.

intermedia Chermock, F. H., *Glaucopsyche xerces* var.
Type Locality: Lone Mountain, San Francisco, California.
Location of Type: Chermock Collection?
Original Description: 1929, Bull. Brooklyn Ent. Soc., vol. 24, p. 20 (Brooklyn, N. Y.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 28, no. 474 (Los Angeles, Calif.). (Places *intermedia* as a synonym of *xerces* form *antiacis* Boisduval.)

invisus Butler, Arthur G. and Druce, Herbert, *Tmolus*
Type Locality: Cartago, Costa Rica.
Location of Type: British Museum (Natural History).
Original Description: 1872, Cistula Ent., vol. 1, p. 108 (London).
Additional References: Butler, A. G., 1874, Lepidoptera Exotica, p. 160, pl. 57, fig. 12 (London). Hewitson, W. C., 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 159 (London). (Makes *invisus* Butler a synonym of *mulucha* Hewitson.).

inyoensis Gunder, Jean D., *Plebeius melissa* tr. f.
Type Locality: Olancha, Inyo County, California, July 2, 1925.
Location of Type: American Museum of Natural History.
Original Description: 1927 (December), Can. Ent., vol. 59, p. 281, pl. A, fig. 1 (Orillia, Ontario).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 27, no. 450 (Los Angeles, Calif.). (Places *inyoensis* as an aberration of *melissa* Edwards.)

iodinus Kaye, W. J., *Tmolus*
Type Locality: Port of Spain, Trinidad.
Location of Type: British Museum (Natural History).
Original Description: 1914 (1913), Trans. Ent. Soc. London, pt. III, p. 569, pl. 30, fig. 12 (London).

ion Druce, Hamilton, H., *Thecla*
Type Locality: Interior of Colombia.
Location of Type: Druce Collection (♂).
Original Description: 1890, Ent. Mo. Mag., Series 2, vol. 1, p. 151 (London).
Additional Reference: Druce, H. H., 1907 (June), Proc. Zool. Soc. London, p. 576, pl. 32, fig. 7 ♂ (type) (London).
Subspecies: *extrema* Draudt.

iopas Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Chontales, Nicaragua.
Location of Type: British Museum (Natural History).
Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 65, vol. 3, pl. 56, figs. 4, 5 ♂ (London).

ira Hewitson, W. C., *Thecla*
Type Locality: Mexico.
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 89, vol. 2, pl. 35, figs. 81, 82 ♂ (London).
Additional Reference: Kirby, W. F., 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 386, no. 117 (London). (Regards *ira* Hewitson as a homonym of *irus* Godart and makes a new name viz. *hewitsoni* Kirby.)

irioides Scudder, Samuel H., *Incisalia* (not Boisduval), Misspelling of *iroides* Boisduval
Type Locality:
Location of Type:
Original Description: 1876 (April), Bull. Buffalo Soc. Nat. Sci., vol. 3, p. 104 (Buffalo, N. Y.).

iris Morris, John G., *Thecla* (not Godart) Misspelling of *irus* Godart
Type Locality:
Location of Type:
Original Description: 1862, A Treatise on some of the insects of New England which are injurious to vegetation, p. 97 (Washington, D. C.).

iroides Boisduval, Jean A., *Thecla*
Type Locality: California.
Location of Type: United States National Museum?
Original Description: 1852, Ann. Soc. Ent. France, Series 2, vol. 10, p. 289 (Paris).
Additional Reference: Oberthür, Charles 1913 (October), Etudes de Lepidopterologie Comparee, fasc, 9, pt. 1, p. 40, pl. 235, fig. 1924 (Rennes).
Synonyms: *immaculata* Cockle, *irioides* Scudder.
Subspecies: *annettae* dos Passos.

irus Godart, Jean B., *Polyommatus*
Type Locality: America?
Location of Type:
Original Description: 1822, Encyclopédie Méthodique, vol. 9, p. 674 (Paris).
Additional Reference: Boisduval, Jean A. and J. LeConte, 1833, Histoire Générale et iconographie des Lépidopteres et des chenilles de l'Amérique Septentrionale, p. 101, pl. 31 (Paris).
Synonyms: *arsace* Boisduval and LeConte, *balteata* Scudder, *iris* Morris.

ismarus Cramer, Pierre, *Papilio*
Type Locality: ?
Location of Type:
Original Description: 1777, Papillons exotiques des trois parties du monde, vol. 2, p. 123, pl. 76, fig. F (Amsterdam).
Additional Reference: Druce, H. H., 1907, Proc. Zool. Soc. London, p. 568 (London). (Did not recognize the species.)

isobeon Butler, A. G. and Herbert Druce, *Tmolus*
Type Locality: Cartago, Costa Rica.
Location of Type: British Museum (Natural History) (Druce Collection.)
Original Description: 1872, (July), Cistula Entomologica, vol. 1, p. 108 (London).
Additional References: Butler, A. G., 1873 (October), Lepidoptera Exotica, p. 161, pl. 57, fig. 2 (London). Godman, F. D. and O. Salvin, 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 74 (London). (Make *isobeon* a synonym of *beon* Cramer.)

isola Reakirt, Tryon, *Lycaena*
Type Locality: Vera Cruz, Mexico.
Location of Type: Strecker Collection (1 ♀).
Original Description: 1866 (November), Proc. Acad. Nat. Sci. Philadelphia, p. 332 (Philadelphia, Pa.).
Additional References: Godman, F. D. and O. Salvin, 1887 (October), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 104, vol. 3, pl. 58, figs. 33, 34 ♂, 35 ♀ (London). Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 102 (New York). Comstock, W. P., 1944 (October), Scientific Survey of Porto Rico and the Virgin Islands, vol. 12, pt. 4, p. 498, pl. 9, fig. 14 ♂ (New York).
Note: Godman and Salvin make the female of *zachaeina* Butler and Druce the female of *isola*.
Synonyms: *alce* Edwards, *nyagora* Boisduval.

isophthalma Herrich-Schäffer, G. A. W., *Lycaena*
Type Locality: Cuba.
Location of Type:
Original Description: 1862, Corresp.-Blatt Zool.-Min. Ver. Regensburg, vol. 16, p. 141 (Regensburg).
Additional Reference: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 110 (New York). (Make *isophthalma* a subspecies of *exilis* Boisduval.)

istapa Reakirt, Tryon, *Thecla*
Type Locality: "Mexico near Vera Cruz".
Location of Type:
Original Description: 1866 (November), Proc. Acad. Nat. Sci. Philadelphia, p. 339, ♀ (Philadelphia, Pa.).
Additional References: Field, William D., 1940, Kansas Univ. Sci. Bull., vol. 26, p. 346 (Lawrence, Kansas). (Makes *istapa* a subspecies of *columella*

Fabricius.) Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 83, pl. 1, fig. 11 ♀ (New York).

itys Edwards, William H., *Thecla*
Type Locality: Prescott, Arizona.
Location of Type: Carnegie Museum, Pittsburgh, Pennsylvania.
Original Description: 1882 (February), Papilio, vol. 2, p. 23 (New York).
Additional Reference: Holland, W. J., 1931, The Butterfly Book, 2nd Edition, p. 238, pl. 29, fig. 17 ♀ (type) (Garden City, N. Y.). (This probably fixes the lectotype.)

ivelia Gosse, Philip Henry, *Thecla*
Type Locality: Paraguay (North bank of Paraná River, October).
Location of Type: British Museum (Natural History).
Original Description: 1880 (September), Entomologist, vol. 13, p. 205, pl. 2, fig. 3 ♀ (London).
Additional Reference: Druce, H. H., 1907 (June), Proc. Zool. Soc. London, p. 577 (London). (Said that the female type is in bad condition, Gosse's figure bad, but it is undoubtedly the female of *Thecla thara* Hewitson, and therefore a synonym.)

ixion Fabricius, Johann Christian, *Papilio*
Type Locality: "In India."
Location of Type:
Original Description: 1775, Systema Entomologiae, p. 523 (Flensburgi).
Additional References: Fabricius, Johann Christian, 1793, Entomologica Systematica, vol. 3, pt. 1, p. 265 (Hafniae). (Includes *ixion* with *mars* Fabricius.) Butler, A. G., 1870, Catalogue of Diurnal Lepidoptera Described by Fabricius in the Collection of the British Museum, p. 190 (London). (Says that *ixion* was distinct from *mars* Fabricius.) Druce, H. H., 1907 (June), Proc. Zool. Soc. London, p. 568 (London). (Says that two British Museum specimens determined as *ixion* by Butler are doubtfully distinct from *T. m-album* Boisduval and LeConte.)
Note: We cannot identify *ixion*.
Synonyms: *euripides* Fabricius, *euripedes* Kirby.

INDEX OF SCIENTIFIC NAMES

Generic names begin with capital letters. New names are printed in italics. This index does not include names published in the list of Lycaenidae (E–I).

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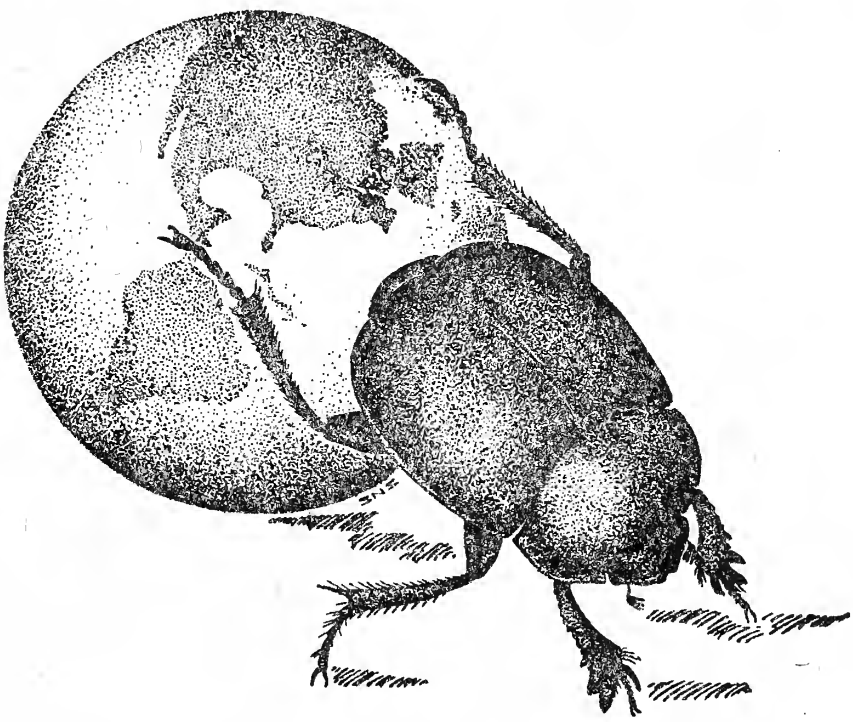

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Journal of the New York Entomological Society

Vol. LXIX March No. 1

ADDITIONAL RECORDS OF NEW ENGLAND SIPHONAPTERA

By Roger F. Cressey

Department of Biology, Boston University

During the years 1955–1959 fleas were collected from various small mammals throughout New England. In addition to my own collections, Dr. Kerwin Hyland of the University of Rhode Island has given me permission to include certain records of fleas identified by me collected in a recent Rhode Island mammal survey. These two sources have provided the basis for this paper. All fleas cited have been identified by the author.

Family PULICIDAE Stephens 1829

Xenopsylla cheopis (Rothschild 1903). MASSACHUSETTS: Boston, October 25, 1959 off *Rattus norvegicus* and November 3, 1959 off *Mus musculus.*

Hoplopsyllus glacialis lynx (Baker 1904). NEW HAMPSHIRE: Coos Co., November 25, 1950 off *Lynx canadensis.*

Cediopsylla simplex (Baker 1895). MASSACHUSETTS: Boxford, October 6, 1957 off *Sylvilagus transitionalis;* Cotuit, May 23, 1959 off *Sylvilagus floridanus.* RHODE ISLAND: Hopkinton, April 1 and April 14, 1957 off *Sylvilagus floridanus.* South Kingstown, November 29, 1955 off same host. East Greenwich, January 21, 1957 off same host. Narragansett, May 1, 1956 off same host. Exeter, October 27, 1955 off *Vulpes fulva.* Hopkinton, October 27, 1955 off same host. Charlestown October 7, 1955 off *Urocyon cinereoargenteus.*

Ctenocephalides felis (Bouché 1835). The many records of cat and dog infestations in New England by this flea are not re-

corded here, since it is generally agreed that this flea is widespread on these two hosts. This flea was also collected, however, from *Procyon lotor* in Warwick, Rhode Island, September 29, 1956 and July 12, 1957.

Family HYSTRICHOPSYLLIDAE Baker 1905

Saphiopsylla bishopi (Jordan 1933). MASSACHUSETTS: Hingham, October 21, 1959 off *Microtus pennsylvanicus.* RHODE ISLAND: Foster, April 24, 1957 off same host.

Stenoponia americana (Baker 1898). MASSACHUSETTS: Billerica, December 7, 1958 off *Peromyscus leucopus.* Holliston, November 29, 1959 off same host. RHODE ISLAND: West Greenwich, December 27, 1956 off *Clethrionomys gapperi.*

Epitedia wenmanni (Rothschild 1904). MASSACHUSETTS: Canton, November 23, 1957 off *Clethrionomys gapperi* and *Peromyscus leucopus.* Hingham, October 21, 1959 off *Peromyscus leucopus.* RHODE ISLAND: Coventry, November 16, 1956 off *Microtus pennsylvanicus.* West Greenwich, December 27, 1956 off *Clethrionomys gapperi.*

Ctenophthalmus pseudagyrtes (Baker 1904). MASSACHUSETTS: Canton, July 28, 1957 off *Tamias striatus.* RHODE ISLAND: Foster, August 16, 1956 off *Clethrionomys gapperi.* East Greenwich, October 30, 1956 off same host. Charlestown, November 10, 1955 off *Microtus pennsylvanicus.* Dutch Island, June 14, 1956 off same host. Scituate, August 28, 1956 off same host. Newport, December 20, 1956 off same host. North Kingstown, March 12, 1957 off same host. Gloucester, June 17, 1957 off same host. West Warwick, November 24, 1956 off *Blarina brevicauda.* Westerly, November 30, 1956 off *Pitymys pinetorum.* North Smithfield, August 10, 1956 off same host. South Kingstown, March 14, 1957 off *Sylvilagus floridanus.*

Doratopsylla blarinae Fox 1914. MASSACHUSETTS: Hingham, October 21, 1959 off *Blarina brevicauda.* RHODE ISLAND: West Warwick, November 24, 1956 off same host. Coventry, April 17, 1957 off same host. Block Island, October 25, 1956 off *Rattus norvegicus.*

Family CERATOPHYLLIDAE Dampf 1908

Oropsylla arctomys (Baker 1904). MASSACHUSETTS: Shirley, August 23, 1958 off *Marmota monax.* Hingham, October

15, 1959 off same host. RHODE ISLAND: The following collection records are all from *Marmota monax.* Exeter, April 18, 1956. Richmond, April 18, 1956. North Kingstown, April 18, 1956. Hopkinton, July 14, 1956. Cumberland, July 25, 1956. Foster, April 22, 1956. Westerly, July 16, 1957. South Kingstown, July 23, 1957.

Odontopsyllus multispinosus Baker 1898. MASSACHUSETTS: Cotuit, May 23, 1959 off *Sylvilagus floridanus.* RHODE ISLAND: South Kingstown, November 29, 1955 off same host. Hopkinton, April 1, 1957 off same host. Kingston, December 15, 1956 off same host. South Kingstown, March 30, 1957 off same host.

Opisodasys pseudarctomys (Baker 1904). MASSACHUSETTS: Hingham, October 5, 1958 off *Glaucomys volans.*

Orchopeas leucopus (Baker 1904). MASSACHUSETTS: This flea was found on *Peromyscus leucopus* in numerous collections in the eastern part of the state. From other hosts it was collected in Massachusetts as follows: Westwood, October 18, 1957 off *Clethrionomys gapperi.* Canton, November 23, 1957 off same host. Canton, June 27, 1957 off *Tamias striatus.* RHODE ISLAND: Block Island, October 25, 1956 off *Microtus pennsylvanicus* and *Rattus norvegicus.* South Kingstown, September 13, 1956 off *Rattus norvegicus.*

Orchopeas howardi (Baker 1895). MASSACHUSETTS: Dedham, April 19, 1957 off *Sciurus carolinensis.* Canton, June 27, 1957 off *Tamias striatus.* RHODE ISLAND: Charlestown, June 14, 1957 off *Urocyon cinereoargenteus.* South Kingstown, June 14, 1957 off *Sciurus hudsonicus.* The following records are all off *Sciurus carolinensis;* Kingston, April 2, 1957. South Kingstown, April 16, 1957. Warwick, May 15, 1957. East Greenwich, November 5, 1957. Scituate, October 9, 1956. Coventry, August 15, 1956.

Ceratophyllus gallinae (Shrank 1803). MASSACHUSETTS: Falmouth, March 1, 1958 from nest of *Sternus vulgaris.* Mashpee, March 31, 1958 from nest of *Colaptes auratus.* Barnstable, May 5, 1957 from nest of *Turdus migratorius.* Dedham, May 8, 1957 from nest of *Passer domesticus.*

Megabothris asio (Baker 1903). MASSACHUSETTS: Westwood, October 6, 1957 off *Microtus pennsylvanicus.*

Monopsyllus vison (Baker 1904). NEW HAMPSHIRE: Gorham, August 29, 1950 off *Mustela vison.*

Nosopsyllus fasciatus (Bosc 1801). RHODE ISLAND: Dutch Island, June 14, 1956 off *Rattus norvegicus.* Block Island, October 25, 1956 off same host.

Peromyscopsylla hesperomys (Baker 1904). MASSACHUSETTS: Canton, July 8, 1957 off *Peromyscus leucopus.* Westwood, September 29, 1957 off same host. Billerica, December 7, 1958 off same host. MAINE: South Portland, August 18, 1957 off same host.

Peromyscopsylla hamifer (Rothschild 1906). MASSACHUSETTS: Hingham, October 5, 1958 off *Microtus pennsylvanicus.*

One of these species of fleas has been found in New England for the first time. *Saphiopsylla bishopi* has not previously been recorded from this area, although Fuller (1943) noted that this flea has been collected in New York state and anticipated the finding of this flea in New England.

Of the twenty species of fleas recorded here the following are reported for the first time in Massachusetts: *Opisodasys pseudarctomys, Peromyscopsylla hamifer,* and *Saphiopsylla bishopi.* Recorded for the first time in Rhode Island Island are *Cediopsylla simplex, Doratopsylla blarinae, Oropsylla arctomys, Odontopsyllus multispinosus, Orchopeas howardi, Saphiopsylla bishopi, Stenoponia americana, Epitedia wenmanni,* and *Ctenophthalmus pseudagyrtes.* In New Hampshire *Monopsyllus vison* is reported for the first time.

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Fox, Irving 1940. Fleas of Eastern United States. Iowa State College Press. pp. 1–191.

Fuller, H. S. 1943. Fleas of New England. Journal of the New York Entomological Society 51 (1), pp. 1–12.

Holland, G. P. 1949. The Siphonaptera of Canada. Dominion of Canada-Department of Agriculture, Publ. 817, Tech. Bull. 70, pp. 1–306.

Johnson, P. T. and R. Traub. 1955. Revision of the flea genus *Peromyscopsylla.* Smithsonian Misc. Coll. No. 123 (4), pp. 1–68.

ECOLOGY OF THE SPIDERS OF A DESERT COMMUNITY[1]

BY ROBERT M. CHEW
DEPT. OF BIOLOGY, UNIV. SOUTHERN CALIFORNIA

INTRODUCTION

There has been only a moderate amount of work on the synecology of spiders. As expected, the data that are available show that this order of arthropods conforms to ecological principles well demonstrated for other groups. For example: (1) Biotic communities have distinct spider faunas, characterized by the frequency and density of the component species, as very nicely shown by Barnes (1953) for *Spartina* tidal marsh and Barnes and Barnes (1955) for the *Andropogon* seral stage in oldfield succession. Holm (1950) found characteristic spiders according to biotopes in Swedish Lapland. (2) There is a distinct change in spider fauna with succession (Gibson 1947, Lowrie 1948, Dowdy 1950, Barnes 1953, Barnes and Barnes 1954). (3) Different spider populations within a community show both spatial stratification (Elliott 1930, Lowrie 1948, Dowdy 1950, 1951, Kuenzler 1958) and temporal stratification, the latter on a diel rhythm (Muma and Muma 1949) and seasonal pattern (Gibson 1947, Fichter 1954, Barnes and Barnes 1955). (4) The interaction of the physical environmental factors of temperature and humidity with the different temperature preferences, upper limits of temperature tolerance, and rates of desiccation of different spiders, is very important in determining geographic, microhabitat and temporal distributions of spider populations (Lowrie 1942, Holm 1950, Nørgaard 1951, Nemenz 1954). (5) Biotic factors also influence distribution, as stressed by Tretzel (1955).

The present report is a part of a more comprehensive study of the ecology of a desert shrub community dominated by creosote bush (*Larrea divaricata*), the widespread dominant of the hot deserts of southwestern North America. The spider populations deserve special attention, since only one other work has dealt with

[1] Contribution from the Southwestern Research Station, American Museum of Natural History, Portal, Arizona. Work supported by National Science Foundation, Research Grant G-5570.

the ecology of desert inhabiting spiders, that of Fautin (1946), treating the ecology of communities in the northern cool deserts of North America, dominated by *Artemesia* over wide areas.

STUDY AREA AND METHODS

The present study was conducted on a fenced 22-acre plot located in the San Simone Valley, 5 miles north of Portal, Cochise County, Arizona (T17S-R31E-S3). The plot, part of the Z-T Ranch, was generously made available for unlimited use by the owner, Mr. Herman Kollmar.

The desert shrub vegetation of this general region probably is a grazing disclimax in an area formerly desert plains grassland. In the study area, total shrub cover was 20.7 per cent, which was almost entirely due to three species: *Larrea divaricata* (creosote bush) 17.35 per cent cover, *Flourensia cernua* (tarbush) 1.12 per cent, and *Parthenium incanum* (mariola) 1.59 per cent. Herb cover was very sparse and only temporary, reaching 1.48 per cent in August, which is about its maximum development. The most abundant herb was a grass, *Muhlenbergia porteri* (0.47 per cent cover), which grew principally under the shrubs. The next three herbs, in amount of coverage, were *Bahia absinthifolia* (composite), 0.24 per cent, *Tridens pulchellus* (grass), 0.21 per cent and *Hoffmanseggia densiflora* (legume), 0.17 per cent.

No long term weather data are available for the immediate vicinity of the study plot, and because of irregularities introduced by the proximity of the Chiricahua Mountains, data for the nearest weather stations may not be very applicable. The San Simone weather station, about 25 miles north of the study plot records an average annual rainfall of 7.9 inches, more than 60 per cent of this coming in the period July through October. April through June is practically without rain. The Portal weather station, 5 miles to the south, but located in the mouth of a canyon, records an annual rainfall of 18.9 inches, with the same seasonal distribution as San Simone. San Simone records show mean monthly temperatures ranging from a low of 7.0° C. in January to 28.6° C. in July.

The arthropods of the shrub stratum in the study area were collected by means of sets of 48-sweeps taken with an insect net 30 cm. in diameter. Usually each individual sweep was from a different bush. Sweeps were taken at about monthly intervals,

from September 1958 through August 1959. Usually 4 sets of sweeps were taken from creosote bush and 2 sets each from tarbush and mariola. For each set of sweeps, individual arthropods were sorted and counted according to species, and fresh weights were measured for species lumped together into certain taxonomic groups.

Individual spiders were examined under a stereoscopic microscope, and the total length of each was measured. Total length was the most easily measured dimension, and in several large samples it proved as reliable in size ranking of individuals as cephalothorax width. Size frequency distributions were plotted using a 0.04 mm. size group basis. The total collections involved 73 sets of 48-sweeps containing 817 individual spiders.

A standard set of 48-sweeps is generally considered to give a sample of arthropods equivalent to that in the vegetation over one square meter of surface. This calibration has been established in the herb stratum in deciduous forest (Shelford 1951) and the same quantitative relationship has been assumed to hold for shrub sweeps (as by Fautin 1946, and others). However the precision with which shrub sweeps can be made is much less than that for herb sweeps. The efficiency of sweeping also varies with the sizes of the individual shrubs (as it limits the length of sweep), and the flexibility of the leaved branches. The three shrubs in the present study varied considerably in these respects. Creosote bush, the largest and most flexible of the shrubs, was the most efficiently swept, while tarbush, the most rigid, and mariola, the smallest, were less effectively swept. In the present methods, two short sweeps from small shrubs were counted as one sweep.

Obviously the most reliable use of 48-sweep data is as density indices in particular shrubs. However, for means of comparison and incorporation with other quantitative data, absolute densities of spiders were calculated in the present study, assuming that 48 sweeps = 1 M^2.

Due to lack of time and of quantitative methods adequate for a desert situation, the arthropods of the ground and subterranean strata, and of the herbs, were not sampled. It is felt that the spiders of these strata are quantitatively much less important than those of the shrubs. Fautin (1946) studied the ground stratum in sagebrush desert, but does not mention any spider as being a significant part of the arthropod communities. In 17

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	20 Sept.		20 Oct. 1958			2 Dec. 1958			4 Feb. 1959		
	L	F	L	F	P	L	F	P	L	F	P
	(6)	(1)	(4)	(3)	(1)	(4)	(3)	(1)	(4)	(2)	(2)
THOMISIDAE											
Misumenops spp. juv.	9.3	7.0	8.5	5.7	4.0	3.0	3.0	2.0			
M. dubius	0.2♂		0.2♂								
(Keyserling)											
M. coloradensis				0.3♂							
Gertsch											
Philodromus				0.3j	2.0j						
infuscatus	0.2♂										
Keyserling	0.3♀			0.7♀	1.0♀						
Tmarus angulatus	0.8j		0.8j	1.3j		1.0j	1.3j			2.0j	
(Walckenaer)						0.3♀					
Ebo albocaudatus n.sp.*		0.3j			2.0j			1.0j			
and *E. parabolis* n.sp.											
SALTICIDAE											
Sassacus papenhoei	3.3j				1.0j	0.8j	0.3j		0.3j	0.5j	
Peckham											
Phidippus sp.	1.2j		0.3j				0.3j				
Habronattus sp.	1.0j										
unidentified	0.2j		0.3j	1.0j	1.0j		0.3j		0.3j		
ARGIOPIDAE											
Metepeira arizonica	0.5j		0.3j	1.7j		0.3j	0.7j	1.0♂	0.3j		2.0j
Chamberlin & Ivie						0.3♂					
Eustala sp.	0.2j								0.5j		
Hamataliva grisea			2.0j			0.8j					
Keyserling											
DICTYNIDAE											
Dictyna peon					1.0j			1.0♂		0.5j	
Chamberlin & Gertsch											
All species											
Total individuals	16.7	7.0	12.3	11.0	12.0	6.3	6.7	5.0	1.3	3.0	2.0
Total biomass, mg.	43.6	35.5	44.5	46.2	40.9	11.8	14.3	12.5	5.7	7.4	2.5

* descriptions of these new species are in manuscript, Dr. Robert Schick.

In addition to the above species, the following spiders were taken only once in sweep collections: DIGUETIDAE, *Diguetia canities* (McCook), 1 individual on *Larrea* 27 Aug. 1959; OXYOPIDAE, *Oxyopes* sp., 1 individual on *Parthenium* 2 Dec. 1958; ARGIOPIDAE, *Peucetia viridans* Hentz, 1 individual on *Larrea* 2 Dec. 1958; SALTICIDAE, *Pseudicius piraticus* Peckham, 1 ♂ on *Larrea* 23 June 1959; MICRYPHANTIDAE, *Grammonota sclerata* Chamberlin & Gertsch, 2 individuals on *Parthenium* 4 April 1959; LINYPHIIDAE, *Meioneta* sp., 1 individual on *Flourensia* 2 Dec. 1958; CLUBIONIDAE, *Chiracanthium inclususm* Hentz, 1 individual on *Flourensia* 16 May 1959. *Xysticus aprilinus* Bryant, THOMISIDAE, was taken in *Gutierrezia* 25 July 1959; this is the only time this shrub was swept.

stomachs of lizards examined in the present study, there was only one spider present in more than 1300 food items; 3 scorpions and 1 solpugid were present in the same stomach contents. If these

4 April 1959			16 May 1959			23 June 1959			25 July 1959			27 Aug. 1959		
L (4)	F (2)	P (2)	L (4)	F (2)	P (2)	L (4)	F (2)	P (2)	L (4)	F (2)	P (2)	L (6)	F (2)	P (2)
11.3	4.0	2.5	9.5	15.5	2.0	7.5	1.5	0.5	5.1	2.0		2.8		4.0
0.3♂	1.5♂		0.5♂			0.3♂	0.5♂		3.3♂	1.0♂	0.5♂	0.3♂		1.0♂
			0.8♀			0.5♀						1.3♀		0.5♀
									2.5♂	0.5♂		0.3♂		0.5♂
						0.3♀			0.5♀	1.0♀				
			2.8j		9.0j	2.5j	2.5j	10.5j	4.8j	4.0j	12.0j	0.8j		2.5j
									0.5♂					
0.3j	0.5j		0.3j	4.5j		1.3j							0.5j	
0.8♀					0.5j	0.3j				0.5j				
1.3j		1.0j	3.8j	4.0j	2.0j	3.3j	1.0j		0.3j			0.5j		
									0.3♂	0.5♂				
									0.8♀			0.3♀		
0.3j	1.0j					1.0j	5.0j	0.5j	0.3j	0.5j		0.2j		
0.3j				0.5j	1.0j	0.3j	0.5j		0.3j	0.5j	0.5j			0.5j
0.3♀														
													1.0j	1.0j
													0.5j	
				0.5j			0.5j			0.5j				
			0.5j			0.3j								
		0.5j						1.5j			1.5j			1.5j
19.5	8.0	5.0	18.0	25.0	14.5	17.5	11.5	13.0	18.3	10.5	14.5	7.0	2.0	12.5
79.2	46.9	26.3	73.6	104.7	19.0	76.9	37.7	16.0	78.3	90.0	27.2	58.9	18.5	88.8

diurnal lizards (*Cnemidophorus*, *Phrynosoma*, *Sceloporus*) can be assumed to be taking a random sample of arthropods present in burrows and on the ground surface, a low density of spiders in these strata is indicated. However, ground dwelling spiders are probably principally active at night, and may not be adequately sampled by lizards.

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	20 Sept.		20 Oct. 1958			2 Dec. 1958			4 Feb. 1959		
	L (6)	F (1)	L (4)	F (3)	P (1)	L (4)	F (3)	P (1)	L (4)	F (2)	P (2)
THOMISIDAE											
Misumenops spp. juv.	9.3	7.0	8.5	5.7	4.0	3.0	3.0	2.0			
M. dubius	0.2♂		0.2♂								
(Keyserling)											
M. coloradensis				0.3♂							
Gertsch											
Philodromus				0.3j	2.0j						
infuscatus	0.2♂										
Keyserling	0.3♀			0.7♀	1.0♀						
Tmarus angulatus	0.8j		0.8j	1.3j		1.0j	1.3j			2.0j	
(Walckenaer)						0.3♀					
Ebo albocaudatus n.sp.*		0.3j			2.0j			1.0j			
and *E. parabolis* n.sp.											
SALTICIDAE											
Sassacus papenhoei	3.3j				1.0j	0.8j	0.3j		0.3j	0.5j	
Peckham											
Phidippus sp.	1.2j		0.3j				0.3j				
Habronattus sp.	1.0j										
unidentified	0.2j		0.3j	1.0j	1.0j		0.3j		0.3j		
ARGIOPIDAE											
Metepeira arizonica	0.5j		0.3j	1.7j		0.3j	0.7j	1.0♂	0.3j		2.0j
Chamberlin & Ivie						0.3♂					
Eustala sp.	0.2j								0.5j		
Hamataliva grisea			2.0j			0.8j					
Keyserling											
DICTYNIDAE											
Dictyna peon					1.0j			1.0♂		0.5j	
Chamberlin & Gertsch											
All species											
Total individuals	16.7	7.0	12.3	11.0	12.0	6.3	6.7	5.0	1.3	3.0	2.0
Total biomass, mg.	43.6	35.5	44.5	46.2	40.9	11.8	14.3	12.5	5.7	7.4	2.5

	4 April 1959			16 May 1959			23 June 1959			25 July 1959			27 Aug. 1959		
	L (4)	F (2)	P (2)	L (4)	F (2)	P (2)	L (4)	F (2)	P (2)	L (4)	F (2)	P (2)	L (6)	F (2)	P (2)
THOMISIDAE															
Misumenops spp. juv.	11.3	4.0	2.5	9.5	15.5	2.0	7.5	1.5	0.5	5.1	2.0		2.8		4.0
M. dubius	0.3♂	1.5♂		0.5♂			0.3♂	0.5♂		3.3♂	1.0♂	0.5♂	0.3♂		1.0♂
(Keyserling)				0.8♀			0.5♀						1.3♀		0.5♀
M. coloradensis										2.5♂	0.5♂		0.3♂		0.5♂
Gertsch							0.3♀			0.5♀	1.0♀				
Philodromus				2.8j		9.0j	2.5j	2.5j	10.5j	4.8j	4.0j	12.0j	0.8j		2.5j
infuscatus										0.5♂					
Keyserling															
Tmarus angulatus	0.3j	0.5j		0.3j	4.5j		1.3j							0.5j	
(Walckenaer)															
Ebo albocaudatus n.sp.*	0.8♀					0.5j	0.3j				0.5j				
and *E. parabolis* n.sp.															
SALTICIDAE															
Sassacus papenhoei	1.3j		1.0j	3.8j	4.0j	2.0j	3.3j	1.0j		0.3j			0.5j		
Peckham										0.3♂	0.5♂				
										0.8♀			0.3♀		
Phidippus sp.	0.3j	1.0j					1.0j	5.0j	0.5j	0.3j	0.5j		0.2j		
Habronattus sp.	0.3j				0.5j	1.0j	0.3j	0.5j		0.3j	0.5j	0.5j			0.5j
	0.3♀														
unidentified														1.0j	1.0j
ARGIOPIDAE															
Metepeira arizonica														0.5j	
Chamberlin & Ivie															
Eustala sp.					0.5j			0.5j			0.5j				
Hamataliva grisea				0.5j			0.3j								
Keyserling															
DICTYNIDAE															
Dictyna peon			0.5j						1.5j			1.5j			1.5j
Chamberlin & Gertsch															
All species															
Total individuals	19.5	8.0	5.0	18.0	25.0	14.5	17.5	11.5	13.0	18.3	10.5	14.5	7.0	2.0	12.5
Total biomass, mg.	79.2	46.9	26.3	73.6	104.7	19.0	76.9	37.7	16.0	78.3	90.0	27.2	58.9	18.5	88.8

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Acknowledgments. I gratefully acknowledge the assistance of

Dr. Herbert Levi, Dr. Willis J. Gertsch and Dr. Robert Schick in making taxonomic determinations of the spiders collected.

RESULTS

DENSITY AND BIOMASS. Table 1 gives the density of spiders in each of the shrub species for each collection. All individuals were weighed together. Total spider density is plotted in figure 1. Densities in the different shrubs show two seasonal highs, one

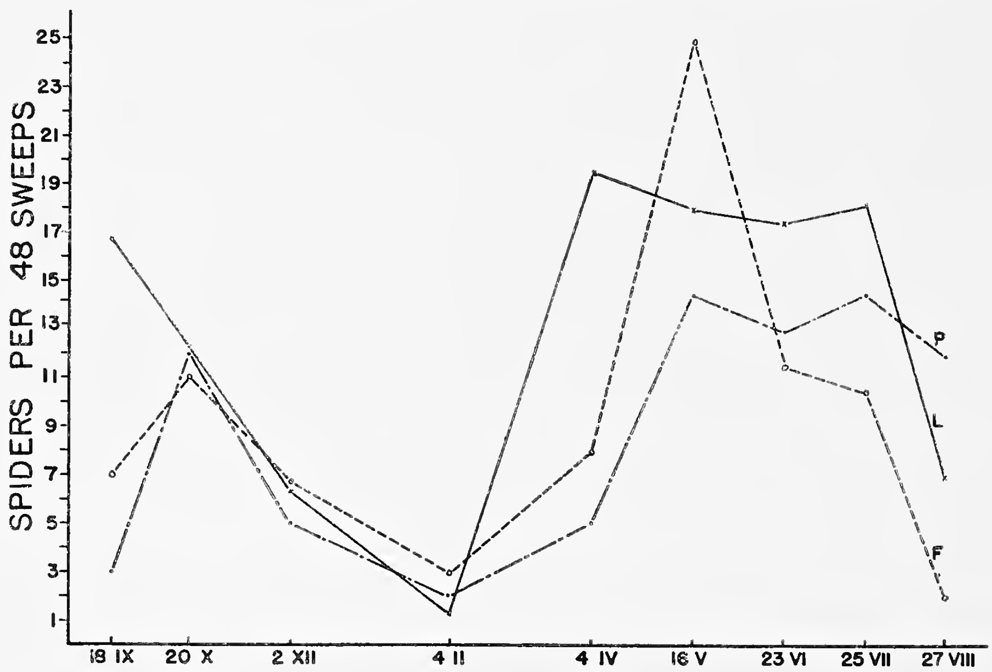

FIG. 1. Seasonal variation in abundance of spiders in the different shrubs. L = creosote bush, *Larrea divaricata;* P = mariola, *Parthenium incanum;* F = tarbush, *Flourensia cernua.*

in the period from April through July, and the second in October. The latter peak is much smaller and more limited in time, and possibly does not occur for creosote bush, which may have only one period of spider abundance, from April through September. The patterns for the three shrubs are somewhat different. Densities in creosote bush remained at almost the same high level from April through July; the spring–summer plateau did not develop in mariola until May, but was sustained through August, while tarbush showed a very sharp peak density, exceeding the other shrubs, in mid May.

The standing biomasses of spiders per square meter of plant cover are plotted for each collection period in figure 2. Figure 3A presents density and biomass per hectare of habitat, which takes into account the relative coverages of the three shrubs. The per hectare figures are therefore dominated by the density

values for creosote bush, which provides 83.8 per cent of the total shrub cover, and *Misumenops* spp. which form 51.8 per cent of the total spiders collected. The numerical dominance of *Misum-*

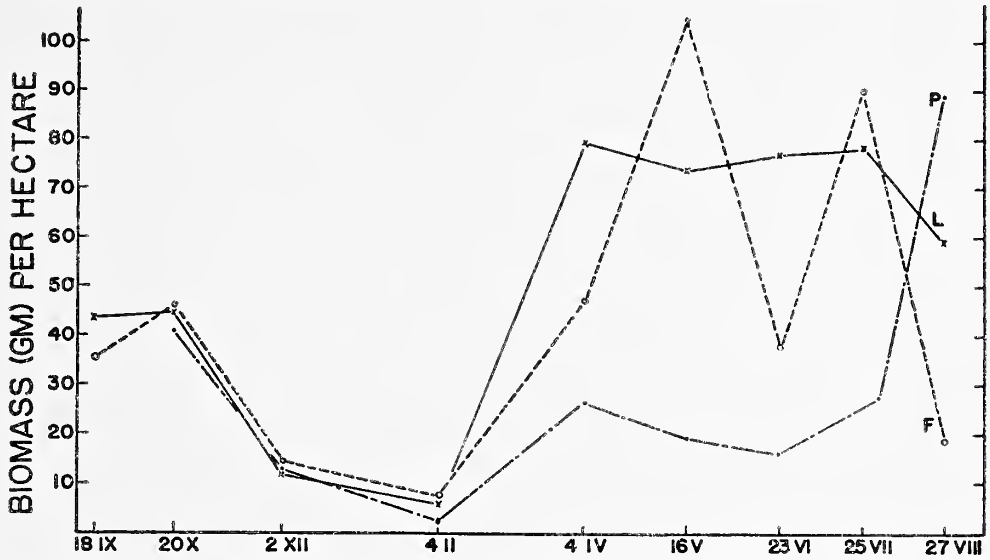

FIG. 2. Seasonal variation of biomass of spiders in different shrubs. L = creosote bush, P = mariola, F = tarbush.

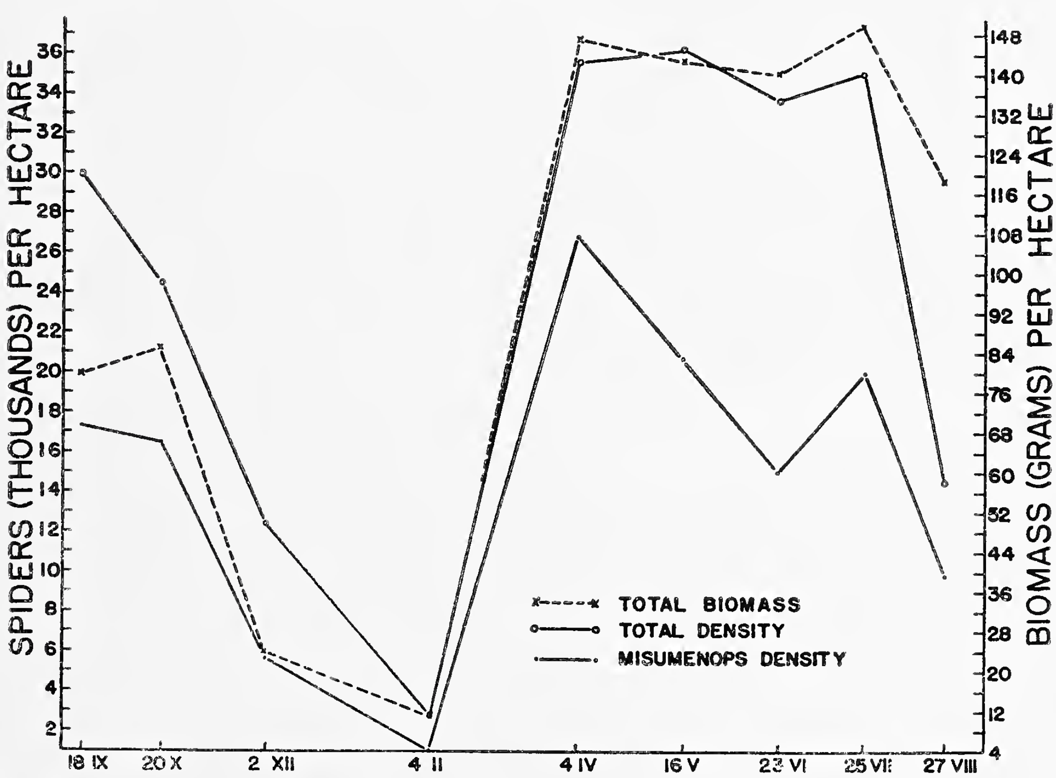

FIG. 3A. Seasonal variations in habitat density and biomass of spiders, and of *Misumenops* spp.

enops is shown by the curve for it alone; seasonal densities of the other spiders are shown in figure 3B, using a magnified abundance scale.

Certain anomalies between the density curve (figure 1) and

biomass curve (figure 2) are largely due to changes in the age structure of the *Misumenops* populations, particularly the number of heavy adults in comparison to the lighter juveniles, and to the plant distribution of the adults. For example: (1) For creosote bush on 18 August, when density was high but biomass only moderate, there were 54 juvenile *Misumenops* for each adult. By 20 October, when density had declined though biomass was almost unchanged, there were 28 juveniles: 7 adults. The decline in numbers (of juveniles) was compensated by the greater weight of the then more numerous adults. (2) The increase in the spider biomass in mariola, which increased from a continuously low level to a sudden maximum in August, was due to the presence

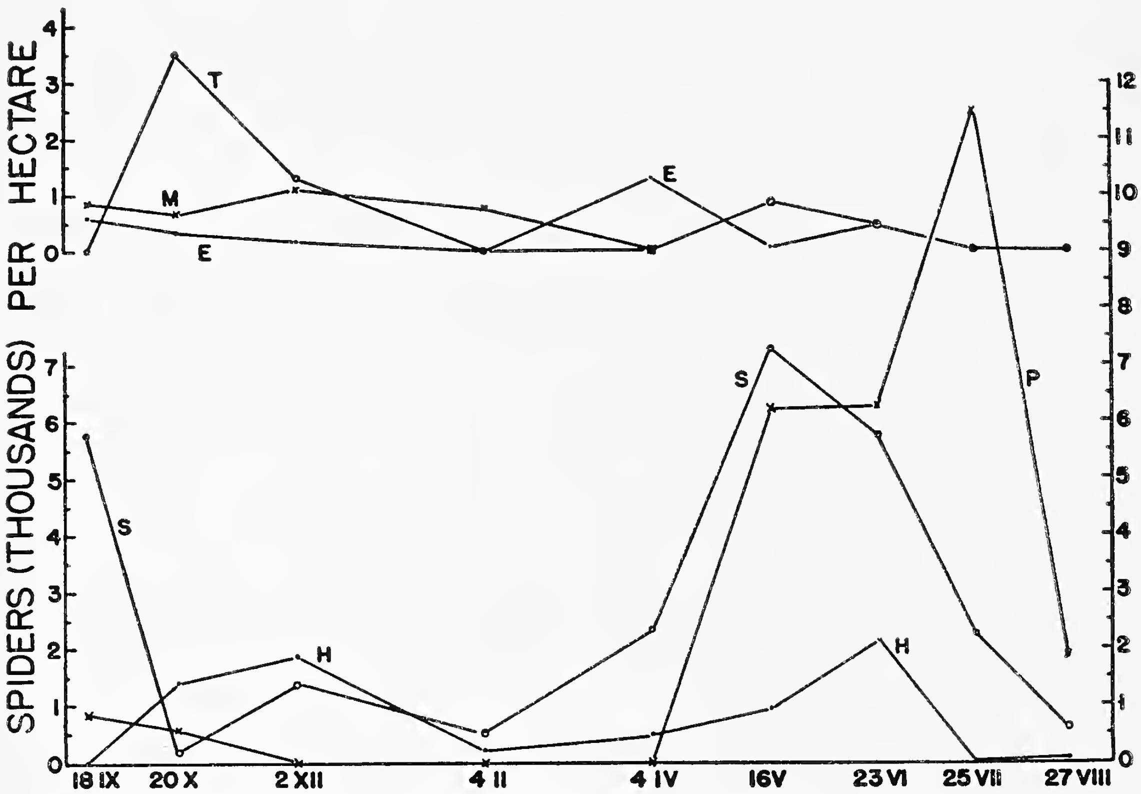

Fig. 3B. Seasonal variations in density of individual species of spiders. Upper graph: E = *Ebo* spp.; M = *Metepeira arizonica;* H = *Hamataliva grisea.* Lower graph: P = *Philodromus infuscatus,* S = *Sassacus papenhoei,* T = *Tmarus angulatus.*

of adult *Misumenops,* not previously present in this shrub, although present on the other two shrubs. The total biomass of spiders (figure 3A) follows rather closely the total density.

Seasonal distribution and climatic factors. The minimum density of spiders in the shrub stratum occurred in February, coincident with the period of lowest air temperatures (figure 4). The lesser depression in density, through August and into September came at the end of the period of sustained high summer

temperatures, when air temperature was declining and air humidity increasing. Highest temperatures and lowest humidities occurred in early June.

SEASONAL DISTRIBUTION AND CONDITION OF THE SHRUBS. The periods of blooming and leaf bearing of the three shrubs, and the seasonal variation in density of the three most abundant species of spiders in these shrubs, are shown in figure 5.

Misumenops spp. are consistently present on the evergreen creosote bush, except during the period of lowest winter temperatures. The plateau density is established in April, at the time of the spring blooming of the creosote bush. In tarbush the maximum *Misumenops* density is a very sharp peak, occurring in mid

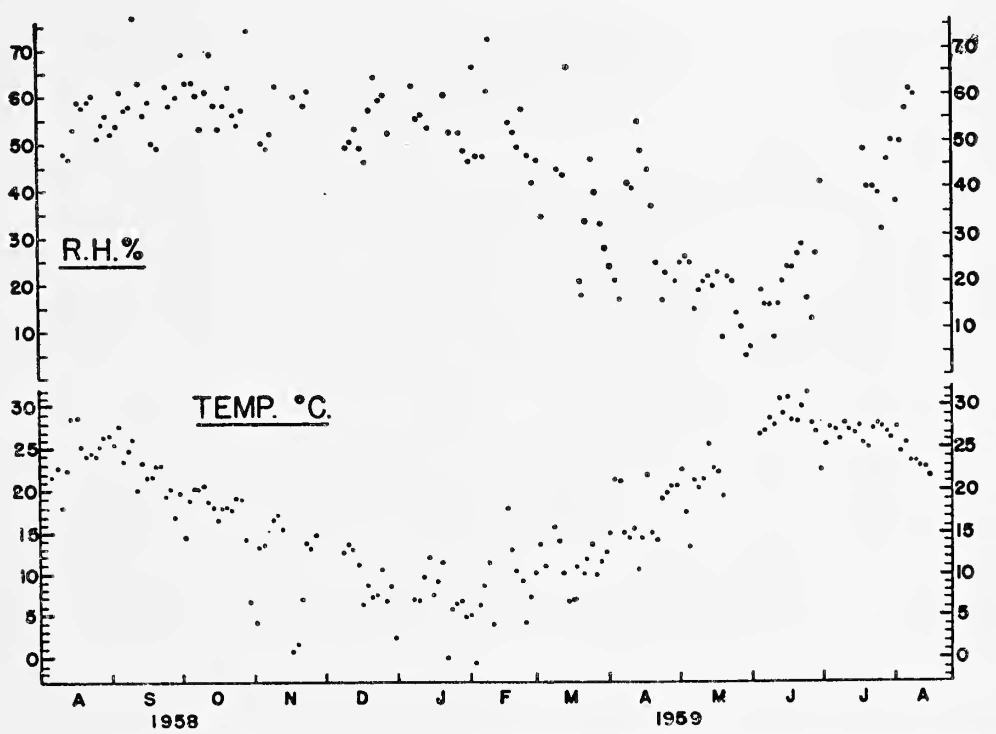

FIG. 4. Air temperature and relative humidity recorded in center of study area.

June, in the first month of full leaf bearing of this deciduous shrub. There is no significant response of density to the blooming period, October–November, of tarbush. For mariola the highest densities are recorded in August and October (no collection in September), both within the blooming period. August was the only time when mature *Misumenops* were found on mariola, and then both species were present.

Philodromus was present abundantly only on mariola, and during the first half of the leaf-bearing period. Density declined in August during the period of blooming, when *Misumenops* became abundant.

Sassacus densities were highest, on all plants, in the period April–June.

DISTRIBUTION ACCORDING TO PLANTS. An analysis of variance of the densities of the more abundant spiders on the three species of shrubs showed that there are significant differences attributable to plant species. (1) The density of *Misumenops* spp. on creosote bush is significantly greater than that on mariola. There is no difference between creosote and tarbush, or tarbush and mariola. (2) The abundance of *Tmarus angulatus* is highly significantly greater on tarbush than on creosote bush ($p. < 0.001$),

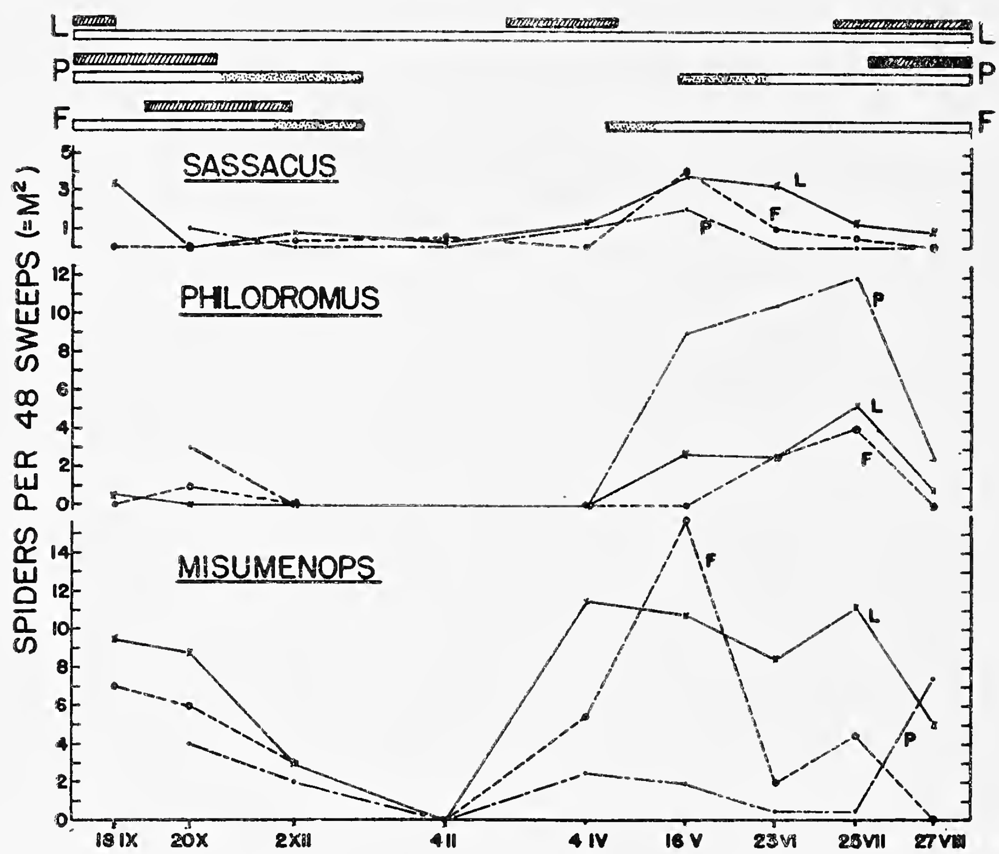

FIG. 5. Variation in abundance of three spiders in the different shrubs, according to the development of these shrubs as shown in the upper bar graphs. L = creosote bush, P = mariola, F = tarbush; cross hatched bars = time of blooming, dotted bar = time of development of leaves or shedding of leaves, plain bar = period of full leaf, no bar = no leaves.

and it was never taken on mariola. (3) The abundance of *Philodromus infuscatus* is significantly greater on mariola than on creosote bush and tarbush. There is no difference between the last two species. (4) *Sassacus papenhoei* and *Phidippus* sp. densities are not significantly different on different shrubs.

Simple inspection of the data in table 1 indicates that the orb-

weavers, *Metepeira arizonica* and *Eustala* sp., are probably distributed independent of plant species, while *Dictyna peon* was taken only on mariola, with one exception, and *Hamataliva grisea* only on creosote bush.

SEASONAL OCCURRENCE AND INSECT BIOMASS. The insect and spider biomasses per 48 sweeps are given in Table 2, according to species of shrub and time of collection. For creosote bush and tarbush, the insect : spider biomass ratios are clearly highest during periods of low spider biomass, and lowest during periods of highest biomass. The largest ratios occurred in February, when insects were still present in the shrubs, while spiders were largely absent. In several cases the spider standing biomass equalled or was larger than the insect biomass.

TABLE 2. COMPARISON OF INSECT AND SPIDER STANDING CROP BIOMASSES PER 48 SWEEPS OF EACH SHRUB SPECIES. Biomass in mgm.

	Insect biomass/spider biomass or prey/predator biomass ratio		
Date	creosote bush	tarbush	mariola
18 Sept. 1958	142.4/43.6 = 3.3	274.4/35.5 = 7.7	
20 Oct. 1958	147.0/44.5 = 3.3	184.6/46.2 = 4.0	162.7/40.9 = 4.0
2 Dec. 1958	36.8/11.8 = 3.2	250.4/14.3 = 17.7	96.3/12.5 = 7.7
4 Feb. 1959	1108.5/5.7 = 195	652.8/7.4 = 88.3	84.7/2.5 = 33.9
2 April 1959	171.0/79.2 = 2.2	723.0/46.9 = 15.4	46.9/26.3 = 1.8
16 May 1959	132.2/73.6 = 1.8	334.3/104.7 = 3.2	53.5/19.0 = 2.8
23 June 1959	107.0/76.9 = 1.4	130.6/37.7 = 2.8	15.6/16.0 = 1.0
27 July 1959	78.0/78.3 = 1.0	152.5/90.9 = 1.7	69.9/27.2 = 2.6
27 Aug. 1959	43.3/58.9 = 0.74	135.1/18.5 = 7.3	226.0/88.8 = 2.5

DEVELOPMENT AND REPRODUCTION

1. *Misumenops dubius* and *M. coloradensis*. As shown in figure 6, both these species had a maximum abundance of mature individuals in late July. However, mature *coloradensis* occurred only in June–July–August collections (except one individual in October), while mature *dubius* were present April through October.

Since it is not possible to distinguish the juveniles of these two species, all *Misumenops* are plotted together in the size distributions of each collection (figure 7A). This plot shows that:

(1) As indicated by the seasonal spread of mature individuals, and the considerable size range in each collection, reproduction takes place throughout a considerable part of the year. But, most breeding must have occurred in July and August when mature individuals comprised 60 per cent and 56.5 per cent of the total numbers respectively.

(2) Penultimate instar males, recognized by partial development of the palpi, were present in October, April–June and August, with the majority in April–June, i.e. preceding the appearance of most of the mature males. Penultimate instar females could not be recognized with certainty.

(3) Eggs were probably laid in late July and August. The

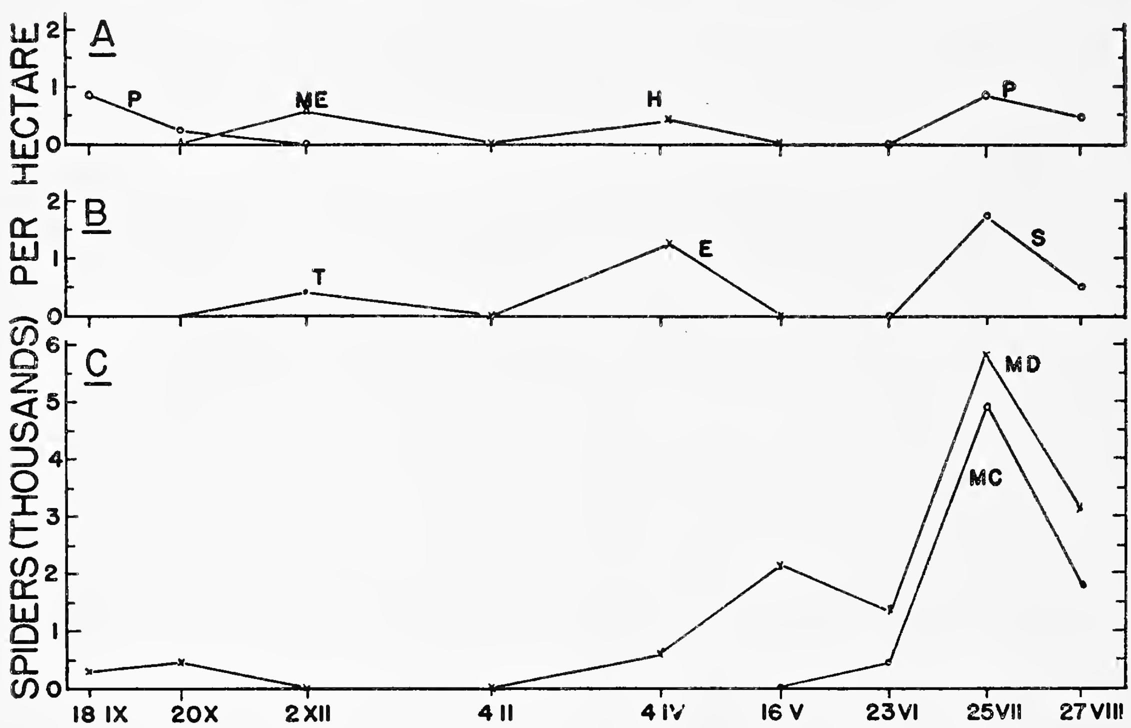

FIG. 6. Density of mature individuals of different spiders. A: P = *Philodromus infuscatus*, ME = *Metepeira arizonica*, H = *Habronattus* sp. B: T = *Tmarus angulatus*, E = *Ebo* spp., S = *Sassacus papenhoiei*. C: MD = *Misumenops dubius*, MC = *Misumenops coloradensis*.

smallest individuals, of the 2nd and 3rd instars, were present in numbers only in August–October.

(4) There was a gradual disappearance of *Misumenops* from the shrub stratum from November through January, until there were none present in February. The disappearance probably is a migration from the shrubs downward into sites of hibernation. *Misumenops* overwinter as juveniles in various instars.

(5) *Misumenops* suddenly reappeared in the shrub stratum in

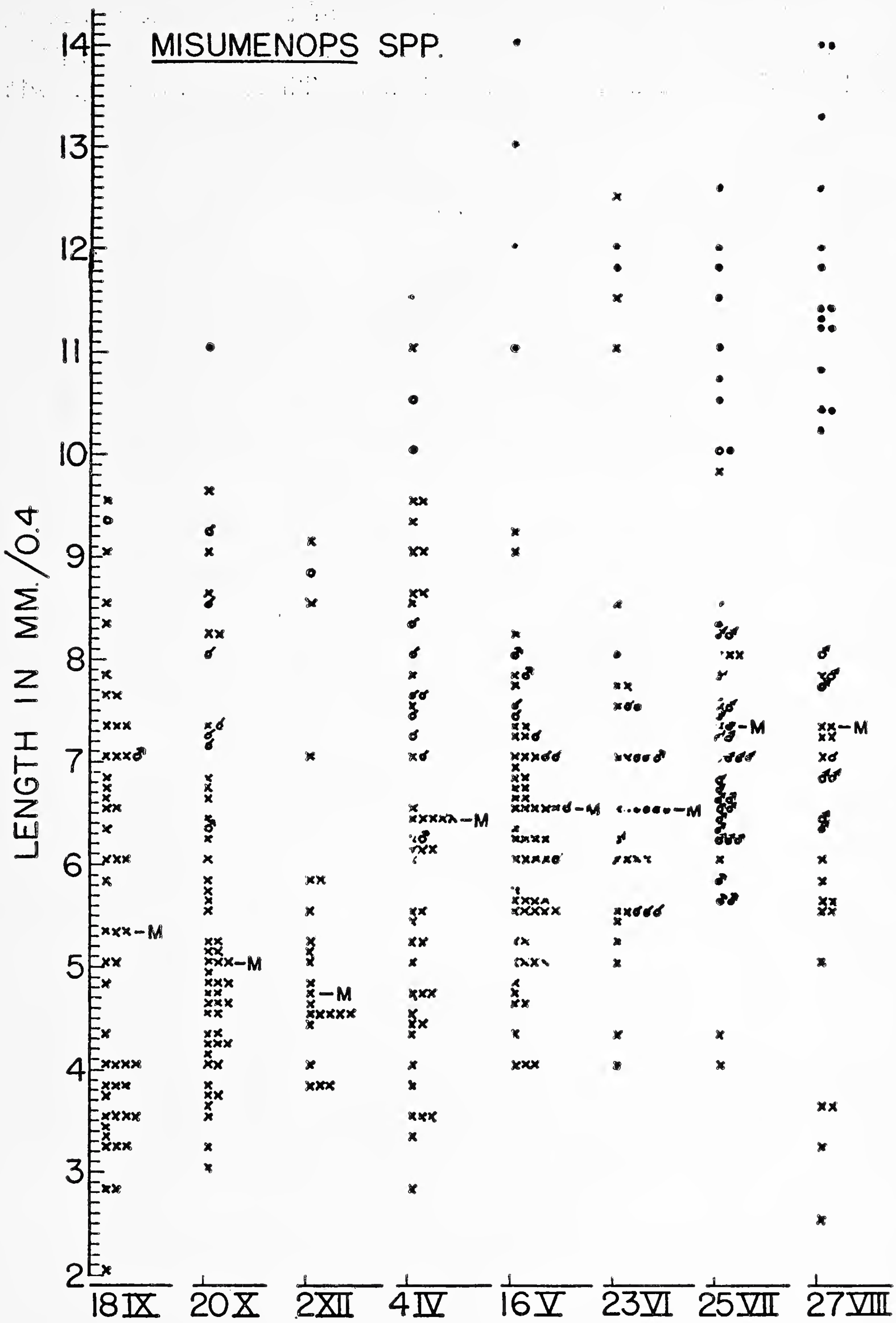

FIG. 7A. Size distribution of individuals of *Misumenops* spp. in the different collections. (No individuals taken 4 II). x = juveniles, ♂ = mature males, ó = penultimate males, ● = mature females, o = penultimate females, M = mode.

numbers in early April, with the mode of the populations being about two instars larger than in November and December, prior to their disappearance from the shrubs. There was then growth

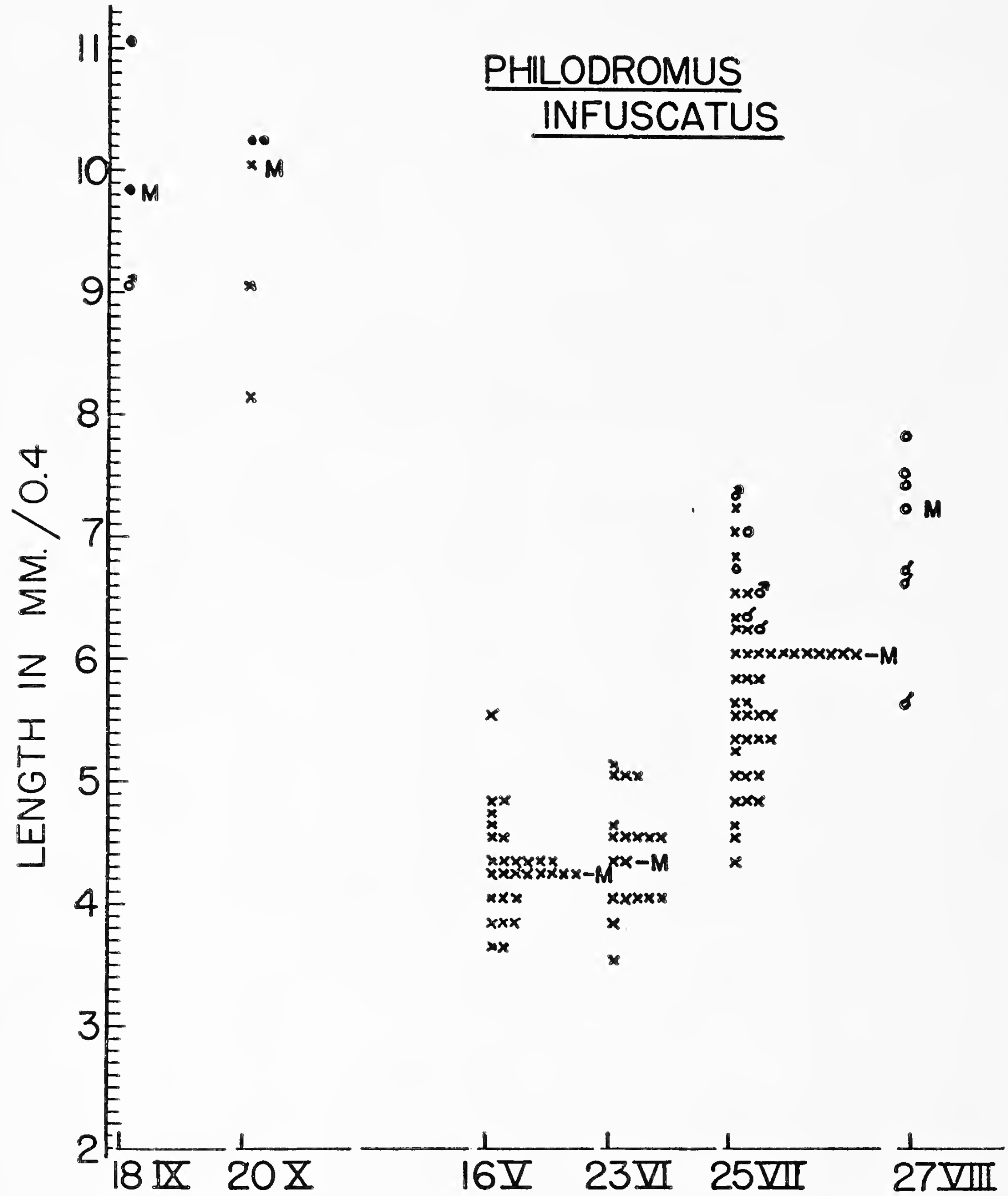

FIG. 7B. Size distribution of individuals of *Philodromus infuscatus* in the different collections. (No individuals taken in collections of 2 XII, 4 II and 4 IV). Symbols as in fig. 7A.

and maturation, with little attrition of the populations, through the penultimate instar to the mature instar in July and August.

When all individual *Misumenops* were placed together in a

single frequency distribution plot, it was possible to recognize what are probably instar groupings, as follows:

Instar	*M. dubius*	*M. coloradensis*
1st	spent in egg sac	spent in egg sac
2nd	1.13 mm.	1.01 mm.
3rd	1.42	1.30
4th	1.82	1.62
5th	2.23	2.02
6th	2.83	2.51 (most mature ♂♂ here)
7th	3.65	3.16
8th	4.66	4.05 (most mature ♀♀ here)

Mature *M. dubius* were significantly larger than *M. coloradensis*.

This instar reconstruction assumes that climatic conditions and other factors that vary with the seasons have no effect on the size of an instar, although they may influence the duration of the instar. Jones (1941) found that temperature and humidity changes had little effect on the length of cephalothorax of *Agelena naevia*. The number of molts interpreted is more than to be expected in general for spiders of this size, and compares to 6 molts for both males and females in *Misumena vatia* and *M. aleatoria* (Bonnet, in Deevey 1949). However, the ratio of increase from one instar to the next was 1.25–1.28, in agreement with Bodenheimer (1933) and Jones (1941) for other species of spiders.

II. *Philodromus infuscatus* (figure 7B) shows a rather clear picture of the simultaneous development of one generation per year. The eggs were probably laid in September and October, when mature individuals formed 2/3 rds of the total collections of this species. Mature *P. infuscatus* persisted in numbers longer than *Misumenops dubius*. *P. infuscatus* disappeared from the shrub stratum for the extended period of November through April, and may overwinter in the egg sac or as very young instars. Collections from May onward showed a steady increase in the modal size of the population, with the first penultimate instar individuals appearing in July. Penultimate females are recognizable by the beginning development of a brown color pattern on the grey dorsum of abdomen and thorax, which is only weakly if at all present in mature males. In August only penultimate individuals were present; apparently there was considerable attrition of the population in the previous month. These individuals reached mature condition in the next two months.

III. *Sassacus papenhoei* (figure 7C) shows a development similar to *Philodromus*, but with certain important ecological differences. Reproduction probably occurred in July and August, as penultimate females and mature males were taken in these months. From September through June there was a clear

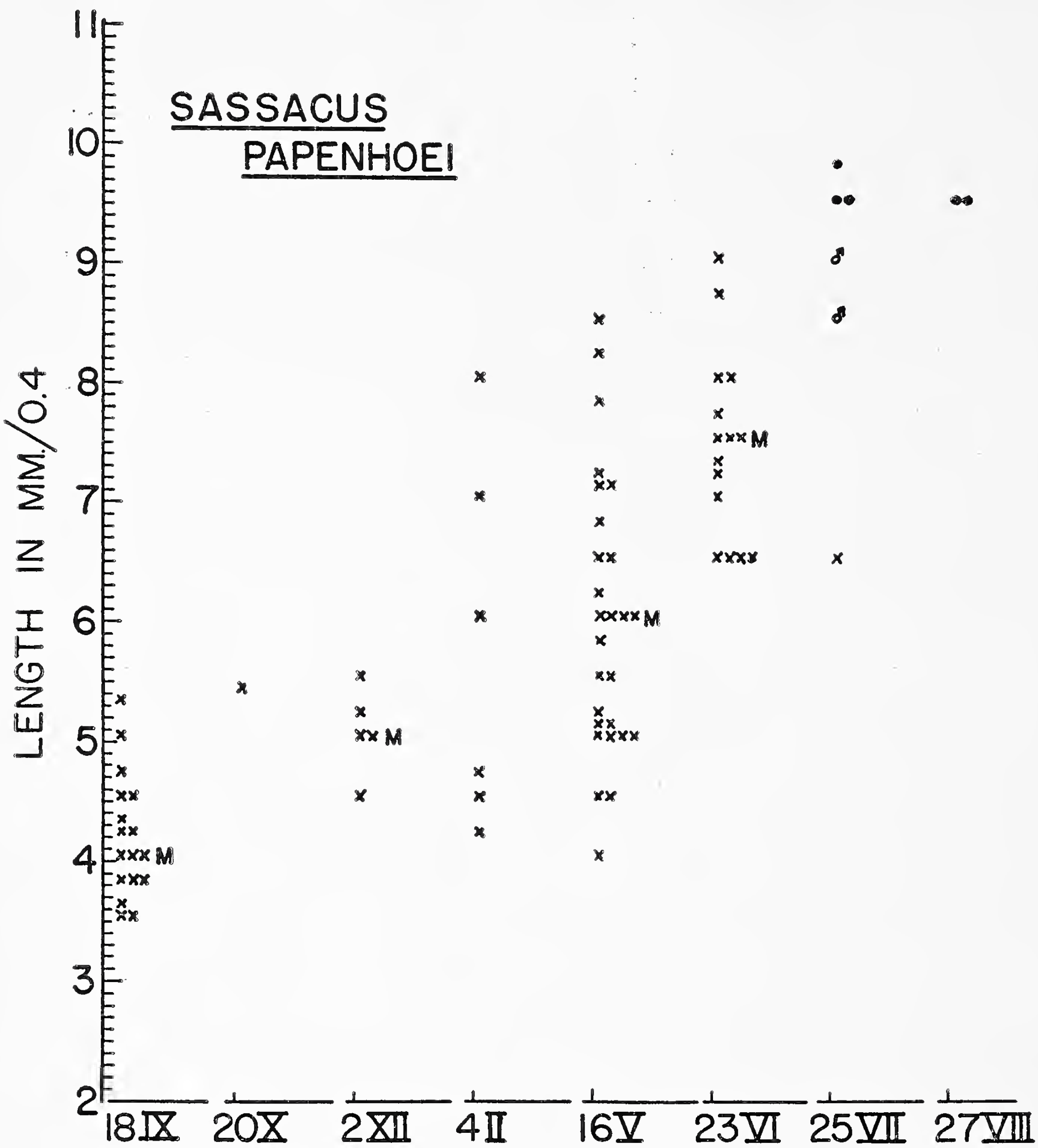

FIG. 7C. Size distribution of individuals of *Sassacus papenhoei* in the different collections. Symbols as in fig. 7A.

linear growth of the individuals, with their continuing presence, though in reduced numbers, through the winter.

Tmarus angulatus probably breeds in May, with the first individuals of the new generation appearing in June. Very few individuals were taken during the summer (none at all in July and September). This may represent an estival migration from the

shrub stratum, or the younger instars may have different ecological preferences. Individuals of this species were present in the shrubs all through the winter, as fairly large juveniles. Penultimate males were first present in May. The one mature female, taken in December, is probably a post-reproductive survivor.

The size distribution and seasonal distribution of *Phidippus* sp. and *Habronattus* sp. was very irregular and could not be interpreted clearly. These may be primarily ground dwelling species, which irregularly enter the shrub stratum.

Captures of a few mature individuals of other species suggests (as plotted in figure 6) that *Ebo albocaudatus* and *E. parabolis* and *Habronattus* sp. reproduce in April, while *Metepeira arizonica* and *Dictyna peon* reproduce in late December.

DISCUSSION

NATURE OF THE FAUNA.

The spider fauna of the present desert shrub community is clearly one that is dominated by only a few species of spiders that ambush or actively hunt their prey rather than snare it. Two species of the same genus, *Misumenops*, comprised 52 per cent of the individuals collected, and 68.5 per cent of the calculated habitat densities. These species of *Misumenops* show the characteristic of ecological dominants (within their size and trophic groupings) of the longest persistence of numbers and of reproduction throughout the year. The numerical subdominants were *Philodromus infuscatus* (16.7 per cent of collections), *Sassacus papenhoei* (10.6 per cent) and *Tmarus angulatus* (4.7 per cent). These five species thus formed 85 per cent of the total number of individuals. Of the 20 species collected, only 11 exceeded one per cent of the collection; 7 species were represented by only 1 or 2 individuals. Web-spinning families (Argiopidae, Dictynidae, Micryphantidae) comprised only 6.1 per cent of the individuals and 6 of 20 species.

This fauna for a southern desert shrub community is quite similar to that found by Fautin (1946) for several associations of the northern desert shrub biome. Fautin found a total of 23 species in four different plant associations, but only 10–19 in any particular association. Of these species, only 4 are mentioned as being quantitatively important: *Philodromus* sp. and *Misumenops celer* (Hentz) (Thomisidae), *Dendryphantes* sp. (Salticidae)

and *Metepeira foxi* Gertsch and Ivie (Argiopidae). There are one species (*Sassacus papenhoei*) and 8 genera in common between these northern and southern collections; two of the common genera, *Misumenops* and *Philodromus*, are numerical dominants in both situations. Fautin collected in both the ground and shrub strata, but does not mention any spiders as being important parts of the ground level society of organisms. In analyses of stomach contents of six species of lizards, he found spider remains occurred with a frequency of 0 to 35.3 per cent, and formed up to 6.6 per cent of the total volume.

The number of species found in these desert studies compares with 17, 31 and 18 species respectively for the beach, foredune and cottonwood seral stages of Lake Michigan sand dune vegetation (Lowrie 1948), 168 for oak subclimax and 122 for beech-maple climax (Lowrie 1948), 39 species for the oak-hickory sere (Dowdy 1950), 139 species (only 30 of which exceeded 1 per cent of the collections) in oak-hickory river terrace forest (Gibson 1947), and an average of 23 species for stands of *Andropogon* (Barnes and Barnes 1955). Direct comparisons of species numbers is impossible because of differences in intensities of collecting and thoroughness of examining different strata in these studies, but it is apparent that the richness of the spider fauna increases with the plant density of the habitat and the degree of stratification. The limited variety of the spider fauna of desert communities, and of the roughly analogous sand dune habitats, is probably due to the low plant density and limited stratification in these situations. A desert community has only ground and shrub strata, with a very temporary herb stratum.

HUNTING VERSUS WEB-SPINNING SPIDERS. As has been nicely shown by Lowrie (1948), hunting spiders predominate in the early stages of succession in deciduous forest and gradually give way to web-spinners towards the climax stage. In the sand dune sere to beech-maple climax, hunting spiders decreased from 71 per cent to 52 per cent of the total species. Dowdy (1950) found 23 web-spinners to 16 hunting species in oak-hickory forest, while Barnes and Barnes (1955) found a ratio of 3 hunting : 2 web-spinning species, and a ratio of 28 : 25 individuals in each category, in the *Andropogon* seral stage of oldfield succession. Desert communities show the most extreme ratio of any situation yet studied (for herb, tree or shrub stratum); the present study

shows a 15 : 4 species ratio and a 50 : 3 individual ratio, and Fautin (1946) found a 16 : 7 species ratio.

In desert communities the low density of shrubs means that there are few situations for web construction. Although desert shrubs provide adequate scaffolding for webs, the windiness resulting from daily extreme temperature changes makes webs very temporary structures. The wind directly damages webs and also destroys them by flexing the branches of the shrubs to which the webs are attached. The branches of creosote bush are particularly flexible and this probably makes this species of shrub least satisfactory, of the three species in the present study, for web spinning. Although web spinning spiders may be conspicuous in a desert community, such as *Araneus carbonarius* in sagebrush (Fautin 1946), it may be that the inefficiency of the temporary webs in capturing food permits the development of only a low population density. It may also be that the predator pressure of spider-hunting wasps may fall more heavily on the orb-weaving spiders than on other types, particularly in habitats with open vegetation (see Rau 1935).

Early stages of deciduous forest seres, like desert communities, have a minimum plant density and stratification, and maximum of air movement for all stages in the sere.

GEOGRAPHICAL DISTRIBUTION OF THE ABUNDANT SPECIES

Of the five most abundant species, four are representatives of genera which are strictly western hemisphere (*Misumenops, Sassacus*) or predominantly so (*Tmarus*), with possible South American origins; only one species is of a genus (*Philodromus*) which is predominantly palearctic and eastern hemisphere in its affinities.

Misumenops, as reviewed by Gertsch (1939), is a discrete genus of the Misumeninae. None of the 11 North American species is apparently congeneric with the species assigned to this genus from the eastern hemisphere. The North American species tend to be limited to southern United States, or at least are more abundant towards the south, especially towards the southwest. Only *M. asperatus* is an exception, being rarer towards the south. *Misumenops coloradensis* Gertsch, 1933, has been reported only from the southwestern states; *M. dubius* (Keyserling, 1880) has

been reported all along the southern tier of states. No ecological data are available for either of these species.

With regard to other species of *Misumenops, M. asperatus* was found as a dominant in black oak forest (Lowrie 1942), and was present in the herb and shrub strata of beech-maple forest (Elliott 1930) and all forested parts of an oak-hickory river terrace (Gibson 1947). *M. celer* was found to be typical of the upper strata of the same river terrace, and was present as a numerical dominant in sagebrush (Fautin 1946). *M. oblongus* was found to be typical of forest borders (Gibson 1947).

In addition to the North American species, Bonnet (1957) lists 31 species from South and Central America which do not get into southwestern United States.

Philodromus (148 species listed in Bonnet 1958) is found on all continents, but principally in the nearctic and palearctic regions. Gertsch (1939) gives 53 species as palearctic, 40 as nearctic and 3 as holarctic.

P. infuscatus Keyserling, 1880, is generally distributed throughout the United States and Canada, however there seem to be no published observations on its autecology. Several other species are also found in southwestern United States; *P. virescens* is common on sagebrush (Fautin 1946, Gertsch 1949). Species of this genus are found only on, or predominantly on vegetation. *P. placidus* was not found until the shrub subclimax stage in the maritime communities of North Carolina (Barnes 1953).

Tmarus (103 species listed in Bonnet 1959) is found principally in South America, with only 6 nearctic and palearctic species. Five species are reported from the United States. *Tmarus angulatus* (Walckenaer, 1837) is generally distributed throughout the United States and into Mexico. Elliott (1930) reports this species as a true forest form, in the herb and shrub strata of beech-maple forest. *T. rubromaculatus* is found in the shrub subclimax of maritime communities in the southeast (Barnes 1953). The other United States species are southeastern in their distribution.

Sassacus (14 species listed in Bonnet 1958) is found only in the western hemipshere. Of the 6 species reported for the United States, only *S. papenhoei* Peckham, 1895, has a general distribution. Fautin (1946) reports it from the greasewood fasciation of the northern desert shrub biome.

COMPARATIVE ABUNDANCE

In the present study, spider densities averaged 10.8 individuals (range 1.2–25.0) per 48-sweeps, for all three species of shrubs combined, and 13.0 per 48-sweeps of creosote bush only. Habitat densities ranged through the seasons from 2800 to 36,300 spiders per hectare, with an annual average density of 24,900 spiders per hectare. These values are quite a bit higher than those found by Fautin (1946) for communities within sagebrush desert, i.e. annual average densities of 1.2–5.4 spiders per 50-sweeps of shrubs, or (calculated from his data) 1340 to 9740 spiders per hectare of the different habitats. Shrub coverages were almost the same in these two desert areas.

As expected, these densities for desert communities, on a hectare basis are lower than densities for more densely vegetated communities. Fichter (1954) found densities, changing through the seasons, of 0 to 250,000 spiders per hectare of the herb stratum in upland true prairie. Weese's data (1924) indicate about 58,000 to 165,000 spiders per hectare, for the lower strata (soil through shrubs) of elm-maple forest. Bristowe (1939) found 280,000 to 918,000 spiders per hectare in undisturbed fields of cock's foot grass (*Dactylis*).

Bristowe (1941) discusses the importance of habitat density to success of mating in spiders.

There seem to be no comparative data in the literature on biomass of spider populations.

FACTORS IN SEASONAL CHANGES IN ABUNDANCE OF SPIDERS

LOW WINTER TEMPERATURES. All species showed a reduced abundance in the shrub stratum in the winter months, January–March, when air temperatures were the lowest for the year. This undoubtedly represents a migratory movement out of the more exposed shrub stratum into the soil litter (very sparse in the study area) and into burrows and crevices in the soil. Such migration is well established for spiders and other arthropods in deciduous forest (Dowdy 1951), and has been attributed particularly to temperature changes (Elliott 1930). *Misumenops* spp. and *Philodromus infuscatus,* the most abundant forms on an annual basis, are completely absent from the shrubs in winter, *P. infuscatus* for the extended period of November through April.

Misumenops overwinter as juveniles, while *Philodromus* probably does so in the egg sac. *Ebo* spp. and *Hamataliva grisea* are also absent in the wintertime.

The other species persisted in the shrubs during the winter, though at a reduced level, except *Tmarus angulatus,* which reached a seasonal maximum in December when air temperatures were only slightly above the January–February minimum. Apparently there are species differences in response to low temperature. Kuenzler (1958) found that several specis of *Lycosa* stay in their burrows when the temperature is below 10° C., and are less active after 2 a.m., possibly because of the lower temperatures then.

SUMMER HIGH TEMPERATURE AND LOW HUMIDITY. Maximum air temperatures and minimum humidities coincided in June. Humidity and temperature were moderated in July and August by the occurrence of rains.

A depressing effect of this combination of temperature and humidity may possibly be seen in the June depression of the *Misumenops* populations, and the fact that the peak abundances of other species occur either after (e.g. *Philodromus*) or before (e.g. *Sassacus*) this time. *Tmarus* is the unusual exception in that a peak of abundance was recorded for it in June.

Spiders are rather tolerant of high temperatures. Holm (1950) found that the ground dwelling spiders in Swedish Lapland had thresholds of heat paralysis as follows: 5 species less than 37° C., 11 species 37–38.9°, 16 species 39–40.9°, 14 species 41–42.9°, 11 species 43–45° and 15 species over 45°. Lowrie (1942) found that two lycosids could tolerate 30 minutes on a surface at 45° C. So, it is probable that the temperatures in the present study area never exceeded the limits of tolerance of the species. However, temperature responses and preferences may be very important in determining microhabitat distribution, and the effects of nonoptimum temperatures in altering activity and development can be important in determining the success of different species in a particular area.

Nørgaard (1951) found a very clear difference in the temperature preferences and tolerances of two lycosids of Danish sphagnum bogs. *Pirata piraticus,* which stays within the sphagnum mat, preferred temperatures of 18–24° C. and showed heat stupor at 35.3°, while *Lycosa pullata,* which is active on the surface of

the mat, and in the sun, chose temperatures of 28–36° and did not show heat stupor until 43.0° C. Holm (1950) found some relationship between the biotope distribution of different species and their temperatures of heat paralysis. Barnes and Barnes (1954) found that the spider fauna of thick beach drift in *Spartina* vegetated areas is characteristically quite different from that in the thin drift on sand beaches; this difference was attributed to the relatively "mesic" and "xeric" microclimatic conditions in the two types of drift.

Response to humidity is insignificant in relation to the response to temperature (Nørgaard 1951). In a limited number of experiments with humidity gradients, Weese (1924) found only weakly expressed preferences: *Acrosoma spinea* (Argiopidae) and *Dendryphantes aestivalis* (Salticidae) tended to select the driest part of a wet-medium-dry gradient; *Epeira gibberosa* (Argiopidae) selected the medium and wet part of the gradient; and, *Anyphaena* sp. selected the wet.

Humidity is probably important only as it interacts with temperature to influence evaporative water loss. Davies and Edney (1952) found that spiders are not far behind insects in their ability to withstand desiccation, and probably have a wax waterproof coating similar to that in insects. Water loss is reduced by closure of the spiracles to the lungs for much of the time. Temperature has little effect on evaporation, up to a critical temperature, when there is a sharp upward break in the rate of evaporation curve. Critical temperatures found for four species, none of which can be considered adapted to xeric conditions, were: over 40–42° for *Meta segmentata* and *Tegenaria derhami;* approximately 40–42° for *Lycosa amentata;* and, approximately 34–36° for *Zilla atrica.* Clearly there are species differences in the rate of desiccation, and possibly in the tolerance of desiccation. Nørgaard (1951) found that *Pirata piraticus* died much more quickly of desiccation than *Lycosa pullata. Dolomedes urinator* dies without water in 4 hours, while *Latrodectus mactans* can live on only the water in its prey (Lowrie 1942). Nemenz (1954) measured the rate of evaporation at 25° C. and 30 per cent relative humidity, and found tremendous interspecific differences, ranging from 2–5 per cent of the initial body weight per day (usually after a higher loss the first day) in *Agelena, Tegenaria, Aranea* and *Theridion* spp., to 12–28 per cent the

first day for *Dolomedes fimbiatus*, and 30–80 per cent the first day for *Agryoneta aquatica.* He concluded that water loss, influenced by a complex of microenvironmental factors, may well influence the biotope distribution of spiders. In an overall study of water balance, Nemenz (1954) found that: (1) no water vapor is taken up through the body surface, (2) all spiders drink when their water deficit becomes great enough, replacing 89–94 per cent of their water loss, (3) the principal loss of water is through the body surface, with loss from the lungs only 1/70th to 1/80th of total loss, (4) no hygrotaxis can be demonstrated, and in gradient experiments there is a preference for intermediate humidities.

Browning (1941), Jones (1941) and Weese (1924) give data from experimental studies on the effect of humidity and temperature on development.

Because of the general resistance of spiders to desiccation, and the different rates of water loss in different species, it is probable that desert environments are not too extreme for many species, but the stress of desiccation, as it limits survival and reproduction, particularly when food (= water) supply is low, probably is an important factor in determining the outcome of interspecific competition.

PLANT DEVELOPMENT. Presence and abundance of spiders in the present study showed some relationship to the state of development of the different shrubs, probably because of the effect of the latter on the productivity of herbivorous arthropods, i.e. the food supply of the spiders. (1) *Misumenops* showed the most stable density in creosote bush, which is evergreen. A high density was immediately established in this shrub as soon as the winter temperatures began to moderate. This also was the time of the spring blooming of this shrub, which would be advantageous to an ambushing spider preying on insects attracted to flowers. (2) *Philodromus,* which has a definite preference for mariola, did not appear until May, when this shrub was beginning to leaf out, after entirely shedding its leaves in the winter. (3) The peak density of *Misumenops* in tarbush did not occur until June, after these shrubs had reached full leaf. (4) *Misumenops* did not have moderate or high densities in mariola except in August to October, which is the period of blooming of this shrub.

FOOD SUPPLY. AMOUNT. The relationship between the num-

bers of arthropods and spiders has been reported in the literature as follows: in shrub stratum of sagebrush deserts, spiders 2.4–8.5 per cent of total arthropods (Fautin 1946); in meadow, spiders 17.1 per cent of total (McAtee 1907); in prairie, spiders 5.8–7.8 per cent of total (Muma and Muma 1949); in the herb stratum of elm-maple forest, spiders 10.2 per cent (Rice 1946) and in maple-red oak sere, 13.9 per cent (Smith-Davidson 1932).

Comparison of numbers of organisms in different trophic levels is often not of much significance, if there are differences in their size and productivity. However, for comparative purposes the present data were calculated in this form. Spiders formed a highly variable part of the total arthropod collections: for creosote bush, 0.12–47.3 per cent, for tarbush, 0.03–37.9 per cent, and for mariola, 0.92–49.8 per cent. The very low percentages were due to large numbers of chermids and/or lace bugs present in certain collections. Average percentages, excluding the latter collections, were: creosote bush, spiders 26.6 per cent of total arthropods, tarbush, 31.0 per cent, mariola, 39.7 per cent. These values are considerably higher than any previously reported.

Assuming that insects are the only food supply of spiders, and that all species of insects are potential prey (excepting those individuals too large for capture, which are omitted in the present calculations), the predator/prey ratios in the present study are: (1) for creosote bush, 36.3 per cent on the basis of individuals and 47.2 per cent on a basis of biomass (from Table 2), (2) for tarbush, 44.9 and 13.3 per cent, (3) for mariola 42.3 and 31.3 per cent. Biomass ratios are even higher if one uses only those groups of insects that are the most likely prey of crab spiders and jumping spiders.

Odum (1959) gives primary consumer/secondary consumer biomass ratios of 8.3 to 36.4 per cent for various fresh water and terrestrial communities. Since the efficiency of conversion from herbivore biomass to carnivore mass is probably 10 per cent or less in general, the herbivorous insects resident in the desert shrubs must have a much higher rate of production than the spiders, in order to serve as the food supply sustaining the latter. The sedentary ambushing spiders in the present study (*Misumenops* spp.) must also benefit to some extent from insects attracted to flowers of these shrubs, but not resident in the shrubs, and thus poorly sampled in the sweeps.

TABLE 3. ANALYSIS OF ARTHROPOD BIOMASS IN CREOSOTE BUSH SWEEPS. Biomass as mg./48 sweeps, percentages as percent of total insect biomass.

	18 Sept.	20 Oct.	2 Dec.	4 Feb.	2 April	16 May	23 June	27 July	27 Aug.
Spiders	43.6 mg.	44.5 mg.	11.8 mg.	5.7 mg.	79.2 mg.	73.6 mg.	76.9 mg.	78.3 mg.	58.9 mg.
Insects	142.4 mg.	147.0 mg.	36.8 mg.	1108.5 mg.	171.0 mg.	132.2 mg.	107.0 mg.	78.0 mg.	43.3 mg.
Heteroptera	41.4 mg.	85.5 mg.	22.0 mg.	1034 mg.**	108.6 mg.	35.3 mg.	13.2 mg.	17.1 mg.	27.5 mg.
	44.7%	58.1%	59.7%	93.2%	63.5%	26.6%	12.3%	22.0%	63.5%
Coleoptera	24.1 mg.	39.6 mg.	3.8 mg.	3.3 mg.	11.8 mg.	8.9 mg.	85.9 mg.	47.6 mg.	9.5 mg.
	25.8%	26.9%	10.3%	0.3%	6.9%	6.7%	80.8%	61.0%	21.9%
Lepidoptera	16.6 mg.	6.3 mg.	8.5 mg.	68.0 mg.	45.1 mg.	52.8 mg.	1.7 mg.	0.0	0.4 mg.
	17.9%	4.3%	23.2%	6.1%	26.4%	39.8%	1.5%		1.0%
Diptera	++	11.7 mg.	1.1 mg.	3.0 mg.	2.6 mg.	0.0	0.0	0.6 mg.	1.3 mg.
		7.9%	3.0%	0.3%	1.5%			0.8%	3.0%
Hymenoptera	++	2.1 mg.	1.4 mg.	0.8 mg.	2.9 mg.	4.8 mg.	2.4 mg.	5.0 mg.	4.5 mg.
		1.4%	3.8%	0.1%	1.7%	3.6%	2.2%	6.4%	10.5%
Orthoptera	3.4 mg.*	0.0	0.0	0.0	*	33.0 mg.	3.8 mg.*	7.7 mg.*	*
	3.6%					24.8%	3.6%	9.9%	
Neuroptera	0.0	1.8 mg.	++	0.0	0.0	0.0	0.0	0.0	0.0
		1.2%							
Others	7.4 mg.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	8.2%								

++ present, but not weighed separately, included under "Others"

* excluding biomass of individuals too large to serve as food for spiders: 18 Sept. 49.4 mg. excluded, 2 April 65 mg., 23 June 13.8 mg., 27 July 41.1 mg., 27 Aug. 62.8 mg.

** Chermids were 1011 mg., 91.1%.

FOOD SUPPLY. QUALITY. The arthropod biomass taken in creosote bush sweeps is itemized according to order in Table 3. Speculation on the relationships of the dominant spiders to this food supply is very tenuous since there is no information on their specific food habits. Bilsing (1920) and Bristowe (1941) give general information on the feeding of spiders, and their conclusions are the basis for most of the following speculations.

The insect biomass attained its highest level in February when spiders were almost completely absent from creosote bush; this peak was almost completely due to the flourishing of chermids, which were almost completely absent from creosote bush except in December, February and April (70, 1174 and 170 individuals/$M.^2$ respectively) though present in other shrubs. Tarbush seemed to be the preferred food plant of the chermids; they were most consistently present in numbers on this shrub, reaching peaks of 1054/$M.^2$ in February, 6160 in April and 925 in September. The chermid density for tarbush was roughly reciprocal to spider density. This reciprocal relationship may be partly due to predator pressure of the spiders on the chermids.

Homoptera, which are generally acceptable to spiders, and hemiptera, which are usually rejected, make up the bulk of the insect biomass in 2/3 of the samples. Chermids are probably a very suitable food for all spiders, of all instars, because of their small size and light chitinization. Diptera, which in general are taken by spiders in larger numbers than any other order of insects, were never present in large amounts (0–7.9 per cent of insect biomass). Small flies were the most abundant forms, and are probably an important food for *Dictyna* and small *Misumenops*. The lepidoptera biomass was almost entirely composed of larvae, which are generally not as acceptable to spiders as the adults. Coleoptera, which were most abundant in two months, generally do not form a large part of the diet of spiders, because of the size, agressiveness, heavy chitinization and distastefulness of many beetles. The last characteristic is particularly true of Coccinellidae, which were one of the most abundant families in the present collections. Bristowe (1941) found that coccinellid larvae were refused by captive spiders. Hymenoptera were never present in significant amounts; they are generally distasteful to spiders, though ants are less so to crab spiders. This order includes potential predators of spiders, particularly crab spiders.

Auten (1925) found four species of hymenoptera and two species of diptera as parasites in the egg sacs of *Philodromus canadensis*, and one species each of neuroptera larva and reduviid adult as possible predators. *Misumenops dubius* has been found extensively in the brood chambers of mud daubers in southern Texas (Gertsch 1939).

There is possibly some cannibalism among the species of spiders in the present collections. Bilsing (1920) observed *Phidippus adax* to feed on *Philodromus* and *Xysticus*. Bristowe (1941) found, however that *Thomisus onustus* and *Misumena calycina* refused spiders offered to them, possibly because they are adapted to ambushing flying insects that come to flowers and do not recognize a crawling arthropod. The same may be true of species of *Misumenops*.

INTERSPECIFIC ISOLATION

A most interesting aspect of the present study is the means of coexistence of different spiders, particularly two of the same genus, in the same area. Since spiders are carnivores with presumably fairly generalized food habits, one can expect considerable competition between even distantly related species. Tretzel (1955) treats extensively the topic of intrageneric isolation and interspecific competition among spiders. The present data are in agreement with his major conclusion that closely related species "live apart in space and time" but that complete isolation is necessary only in specific situations. Interspecific competition among spiders in the area studied is reduced in several fashions: (1) vertical separation of the shrub dwelling species from ground dwelling species; (2) horizontal separation of the shrub dwelling species by their occurrence on different kinds of shrubs; (3) general differences in the type of food, largely a result of differences in behavior in capturing food; (4) seasonal differences in the time of reproduction and time of maximum abundance.

VERTICAL STRATIFICATION. *Misumenops, Philodromus, Tmarus* and most of the other genera in the present collections, as far as can be judged from the literature, are typically plant dwelling spiders, and hence do not come into competition with the ground dwelling forms. The extent to which the different jumping spiders in the collections range onto the ground is not known. The irregularity of the size frequency distribution of *Phidippus* in

the different shrub collections suggests that this species may inhabit both the ground and shrub strata, the latter possibly being of secondary importance. The completeness of the developmental record of *Sassacus papenhoei* in shrub sweeps (figure 7C) suggests that it is primarily a shrub dwelling species.

Vertical stratification of spiders has been described in forest communities. Such stratification has been attributed to temperature differences, which are particularly distinct between the soil stratum and overlying vegetation. This ground to shrub difference would be extreme in desert communities. Elliott (1930) found no difference between the spiders of the herb and shrub strata of deciduous forests and proposed that physical conditions were not sufficiently different to cause stratification. Weese (1924) emphasized the "narrowly limited" stratification of web-spinners, in which temperature and humidity are less important factors than suitable substratum. However, Lowrie (1942) concluded that humidity is probably more limiting than special substratum for web-spinners. Kuenzler (1958) found vertical stratification between three species of *Lycosa*. Tretzel (1955) considers that vertical stratification is secondary to horizontal separation, and he is almost alone in emphasizing the importance of biotic factors in such separations.

HORIZONTAL SEPARATION. The basis for the clearly demonstrated plant preferences—*Misumenops* spp. for creosote bush, *Philodromus* for mariola, and *Tmarus* for tarbush, probably lies in the advantage of the concealing coloration gained in these combinations. *Philodromus infuscatus* has the same light gray color as the leaves of mariola; the brown and gray mottled *Tmarus* matches the stems of tarbush better than the other shrubs; *Misumenops* show a range of colors, particularly of the large abdomen—brown, yellow-brown, yellow, yellow-green, green, reddish, allowing them to blend with the live, green leaves of creosote bush, with its yellow flowers, or with the yellows and browns of dying leaves. *Tmarus angulatus* is also concealed by its body shape, the posterior-dorsal projection of the abdomen; at rest it clasps a twig with its legs, and by its form resembles a bud or petiole stump (Comstock and Gertsch 1940).

The concealing coloration of these genera has been frequently noted in the literature. For example: *Philodromus virescens* has the same bluish-gray color as sagebrush, on which it is com-

monly found (Gertsch 1939). *P. alascensis* has a gray coloration like the sand of the foredunes where it occurs (Lowrie 1942). The red markings of *Misumenops asperatus* allow it sometimes to resemble exactly the flowers of *Rhus acetosella* on which it occurs (Lovell 1915).

The ability of Misumeninae to change color also has been often remarked. Pearse (1911) found that 84 per cent of the white individuals of *Misumenoides aleatorius* and *Misumena vatia* were collected from white flowers, while 85 per cent of yellow individuals were from yellow flowers. Gertsch (1939) found that *Misumenops asperatus* is able to reversibly change its color. Gabritschevsky (1927) studied this response in various instars of *Misumena vatia.* He found that the white coloration is due to permanent deposits of guanin pigment, and a pink pigment also develops and accumulates with age. Yellow pigment, which masks the white, is temporary and develops in response to reflected yellow light. Only mature spiders can form this yellow pigment. The change from white → yellow can be accomplished in 1 to 10–20 days, and a return to white in 5–6 days.

Specific plant preferences have been noted for a few other spiders. Fautin (1946) found *Sassacus papenhoei* in the shrubs of the greasewood fasciation of sagebrush desert, but not in other communities. Dowdy (1950) found *Dictyna volucripes* abundantly in *Lespedeza,* but rarely in *Scirpus—Echinochloa* only 45 yards away. There may also be a response to a habitat type rather than plant species. Blake (1926) concluded that the simple presence of a forest cover was a major factor in the occurrence of forest spiders. Of the 48 species classified as true forest spiders in beech-maple forest, 46 also occurred in oak-hickory and 40 in elm-maple (Elliott 1930).

ISOLATION BY FOOD AND FEEDING HABITS. By their mode of life and their hunting methods, different spiders tend to contact particular kinds of insects and become adapted within wide limits to capturing and feeding on these kinds (Bilsing 1920, Bristowe 1941). This seems to be the case for the crab and jumping spiders of the present study.

No specific observations have been published on *Misumenops,* but species of this genus are stated to all be semisedentary and ambushers of their prey, as are *Misumena* and *Misumenoides* (Gertsch 1939). Therefore, these spiders probably are dependent

on insects that are attracted to flowers, such as various flies and bees; beetles coming to flowers may be fairly immune to capture. Crab spiders more often attack and successfully capture prey larger than themselves than do jumping spiders. *Misumena vatia* sometimes makes no attempt to go after its prey, but waits until an insect flies or walks into range of its elongate front legs. As observed by Thomas (1952) the behavior of *Misumena vatia* and several other ambushing crab spiders is adjusted to the kind of prey, as if the spider were instinctively informed of the means of defense of each kind of insect. These spiders were observed to circle a bee until they had an opportunity to bite into the back of the neck and quickly paralyze the large prey. If this approach could not be made, the spider abstained from attacking. Other approaches occurred only accidentally when the prey moved suddenly. Flies and other unarmed insects were grasped ventrally or in any chance position, and were not necessarily paralyzed by a neck bite before feeding began. Bristowe (1941) found that *Misumena* and *Thomisus* may ignore crawling insects, possibly because they are instinctively accustomed to flying forms.

Tmarus and *Philodromus* also probably largely depend upon lying in wait for their prey, taking advantage of their concealing coloration, but they frequently change their position, and thus presumably encounter and capture insects that are not concentrated by the attraction of flowers, such as the different homoptera and hemiptera that are sucking juices on various parts of plants.

Many jumping spiders, and presumably *Sassacus papenhoei*, actively search for and pursue their prey. Because of their supposed superior sight, and their extreme mobility, they may not need the additional advantage of concealing coloration. The abundant jumping spiders in the present study showed no plant preferences. Bilsing (1920) found *Phidippus* feeding principally on hemiptera, hymenoptera, orthoptera and diptera. No beetles were observed to be taken. Insects' immunity from attack from these active hunting spiders depends on larger size, chitinization, disagreeable odor or taste, and/or warning movements.

Dictyna are able to capture only very small insects, as flies, which they can trap in their small webs. Argiopidae, such as the *Metepeira labyrinthea* observed by Bilsing (1920) probably have

the most diverse diets, i. e. anything palatable that blunders into their extensive webs.

Peak of reproduction and abundance. Most of the spider populations in the present study area had different times of maximum abundance (figure 3), except that most of them are overlapped by *Misumenops,* and there is also a certain separation of the times of reproduction, as estimated from the abundance of mature individuals. Similar temporal separation of peaks of abundance is seen in the graphs of Weese (1924), and the importance of temporal isolation of times of reproduction is stressed by Tretzel (1955). Since a spider population's food requirements are greatest during its peak of abundance, and at the time of reproduction, any separation in time of these periods for different species is advantageous in reducing competition and allowing a more diversified group of species to fit together in a community.

Misumenops dubius versus *M. coloradensis.* These two species have their peaks of reproduction at the same time and have the same plant preference. Judging from the numbers of mature individuals, *dubius* was somewhat more abundant. The copulatory organs of the two species are quite distinct, and this is probably the major barrier to their interbreeding. The period of abundance of mature *coloradensis* is seasonally more limited than that of *dubius,* and this is probably of secondary importance in reproductive isolation of the species.

With the continuing faith in the "principle of competitive exclusion", or "one species to a niche" (Hardin 1960), it may be assumed that there is some ecological difference yet to be discovered between these two very closely related species that allows them to coexist successfully. There are other instances of coexistence of species of the same genus. Kuenzler (1958) in a study of three species of *Lycosa,* could find no apparent factors separating two of them; the smallness of their home ranges and certain differences in the way they wander over this area may be important. Tretzel (1955) in an intensive study of 365 species in the vicinity of Erlangen, Germany, found four pairs of species coexisting, the members of each pair having apparently identical ecological requirements and similar times of reproduction. However, all of these situations showed characteristics that may explain their coexistence. (1) All pairs lived in habitats with a greater than average food supply, and showed considerable movement between strata. Both of these conditions would reduce the

importance of competition for food as can possibly be interpreted for other situations reported in the literature, for example Ross (1957) for coexistence of sycamore leafhoppers. If there is a surplus food supply for two species having the same food requirements, and if other factors are operative to prevent their increase to the point of full utilization of their food supply, they may then coexist without competition. This can particularly be pictured as happening in a habitat having physical conditions considerably suboptimal for both species. (2) In three of the four pairs, one species showed a peripheral abundance around a center of distribution where it was less abundant, while the other species was centrally abundant. This possibly represents a situation where a horizontal ecological separation is developing. One species with greater range of tolerance is moving out into a peripheral region, initially less suitable, and gradually disappearing from the central region where the other species has a slight competitive advantage. That is, this is a situation where elimination of one of two species from the same niche is slowly in progress. It is not known whether either of these situations exists with regard to *M. dubius* and *M. coloradensis*, but their example supports Tretzel's conclusion that "the necessity for intrageneric isolation is compelling only under entirely specific conditions".

SUMMARY AND CONCLUSIONS

1. The spiders of a southern desert shrub community were studied by analysis of 48-sweep collections from the dominant (*Larrea divaricata*) and subdominant shrubs (*Flourensia cernua* and *Parthenium incanum*).

2. The spider fauna of 20 species was dominated by *Misumenops dubius* and *M. coloradensis*, with *Philodromus infuscatus*, another crab spider, and *Sassacus papenhoei*, a jumping spider, as numerical subdominants. Only these four species exceeded 5 per cent of the total number of individuals; 11 species exceeded 1 per cent.

3. Spider abundance ranged from 2800 to 36,000 per hectare, and biomass ranged from 11 to 150 grams per hectare. The number of spiders in the shrubs reached a minimum in February, when winter temperatures were lowest. A fairly constant density, more than 50 per cent *Misumenops*, of 34,000 to 36,000 per hectare was maintained from April through August.

Individual species showed peak densities before or after the June period of maximum temperature and minimum humidity. *Misumenops,* which were abundant from April through September, showed a depression of numbers in June. *Tmarus angulatus* was unusual in showing its highest numbers in June and December.

4. Densities per unit of vegation ranged from 2.0 to 25.0/M^2, and biomass from 2.5 to 104.7 mg./M^2. There was some variation of density attributable to the degree of development of leaves and flowers of the different shrubs.

5. Three species of spiders showed definite shrub preferences, *Misumenops* spp. for *Larrea, P. infuscatus* for *Parthenium* and *T. angulatus* for *Flourensia.*

6. *Misumenops* spp. reproduce throughout much of the year, but principally in July and August. They move completely out of the shrub stratum in winter, overwintering as juveniles of different instars, and then quickly return to abundance in *Larrea* with moderation of winter temperatures in April. Male *Misumenops* reach maturity in about the 6th instar and females in the 8th.

7. *Philodromus infuscatus* reproduce only in September and October; after a long period of absence from the shrub stratum, possibly overwintering in the egg sac, individuals develop synchronously to maturity.

8. *Sassacus papenhoei* also has only one generation per year, born in July and August, and developing uniformly. This species remains active in the shrubs in winter.

9. Biomass ratios of spiders (predators) : insects (prey) averaged 13.3–47.2 per cent for the different shrubs. The insects must have a much greater rate of production to be able to serve as the food base for the spiders.

10. Spider densities in this southern desert shrub vegetation are considerably higher than those reported for northern desert shrub (sagebrush) but less than the densities reported for more densely vegetated communities.

11. The predominance of crab spiders and jumping spiders (hunting forms) over web-spinners (ratio of 50 : 3 individuals) is probably due to the sparseness of the vegetation, which provides few sites for webs and leaves orb weavers exposed to predators, and to high air movement, destructive to webs.

12. The temperature and evaporative stress of this desert area do not exceed the limits of tolerance of many spiders, but these factors are undoubtedly important in selecting those species than can best survive. The literature shows that there are considerable differences in the preferences, temperature of heat paralysis and critical temperature for water loss of different spiders.

13. The coexistence of the two species of *Misumenops,* having the same time of reproduction and same plant preferences, and presumably similar food habits, cannot be explained with the present data.

14. Competition between *Misumenops* spp., *P. infuscatus, T. angulatus* and *S. papenhoei* is reduced by their partial horizontal separation onto different kinds of shrubs, general differences in food habits, and temporal separation of periods of peak abundance of numbers and of reproduction.

The basis for the plant preferences is probably the concealing coloration gained on the preferred plant.

Misumenops are semisedentary ambushing spiders and probably depend largely on diptera and hymenoptera attracted to flowers. *Philodromus* and *Tmarus* probably depend on ambushing tactics to capture food, but move about and thus presumably contact and depend upon the various heteroptera for food. *Sassacus* probably actively seeks and pursues its prey.

15. Though the spider fauna of this desert shrub vegetation is not very diverse, it is developed to exploit rather fully the limited resources of the desert habitat.

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TERRITORIALITY AND DISPERSAL IN DRAGONFLIES (ODONATA)[1]

By EDWARD J. KORMONDY

DEPARTMENT OF ZOOLOGY, OBERLIN COLLEGE, OBERLIN, OHIO

Investigation of territoriality occurred first in birds and led eventually to Howard's (1920) clarifying exposition, Heape's (1931) extension of the concept to other animals, and ultimately to the widely accepted precept that it is a behavioral phenomenon characterized by an organism maintaining a "defended area" (Nobel, 1939; Nice, 1941). Carpenter (1958) has reviewed territorial behavior in vertebrates; there is no comparable review for invertebrates. Carthy's (1958) study on invertebrate behavior contains no reference to territoriality; Thorpe (1956) has only a cursory statement about the phenomenon in higher crustacea and a few insects. Aside from the several papers on Odonata to be discussed presently, territorial behavior in invertebrates has been postulated on sound evidence for only a few forms such as the fiddler crab *Uca* (Verwey, 1930 and Crane, 1941), the burrowing beetles of the genus *Necrophorus* (Pukowski, 1933) and the ants *Formica rufa* (Elton, 1932), and *Formica fusca, Acanthomyops niger* and *Myrmica scabrinodis* (Pickles, 1935). The lack of attention to territoriality among invertebrates may be occasioned by infrequent occurrence; however, it *may* also be the case that it is not being recognized because of a too rigid concept of what constitutes this type of behavior.

If in the more intensively studied vertebrates it can still be stated that in the investigation of territoriality, information is largely limited and qualitative, and formulation and testing of hypotheses is merely beginning (Carpenter, 1958), one can underscore the same limitations as regards invertebrates. While there is need for compilation on this level, the present paper is restricted to a review of territorial behavior only in dragonflies—its occurrence, characteristics, significance and possible relationships with dispersal.

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TERRITORIALITY

During a study of the systematics of the species of *Tetragoneuria* occurring in the Great Lakes region (Kormondy, 1959), territorial behavior was observed in several species, notably *Tetragoneuria cynosura* (Say). Marking studies, largely inconclusive, were combined with observation to investigate a number of behavioral characteristics, among them territoriality. In this activity, males on a lake shore are spaced in intervals varying directly with the population density, the latter in turn varying both seasonally and diurnally. At the time of greatest seasonal density males flew in intervals of 10 to 30 feet, 1 to 3 feet from shore and 3 feet above the water; these spaces coincided closely with microtopographic areas delimited by overhanging shrubs if the latter occurred in the habitat. There is a tendency for the male to become localized in these microtopographic areas, or at least in given sectors of the area. This localization tendency was tested artifically by swishing a net near the male, who either shifted to a spot some 10 to 20 feet away, or flew upward some 30 feet and returned to the same position. Localization is observed also in response to incursions by similar-sized dragonflies which resulted in an exploratory response of quick flight and were almost invariably followed by a return to the original area. The flight pattern of the male at this time is characterized by extended periods of hovering (up to 15 minutes or longer), considerable maneuvering and no alighting. By contrast, feeding flight occurs away from the water, and is characterized by little or no hovering, both vertical and considerable horizontal displacement, and a height of usually 6 feet above ground. No spacing, although some tendency to localize, occurs in feeding behavior.

When the *Tetragoneuria cynosura* male is in his territory and is approached by another *cynosura* of either sex, the exploratory response, a quick flight simulating a chase, gives way to aggressive behavior. Visual perception of another *cynosura* appears to be the mechanism releasing aggressive behavior. This aggressive behavior appears to be sexually motivated since there is an attempt by the occupant male to achieve the precopulatory tandem position with the intruder regardless of its sex. If the intruder is a male, agonistic reactions displace sexual ones, and

a clash or "fight" occurs; if the intruder is a female, copulatory activity ensues. The stimuli allowing the perception of sex upon contact are unstudied.

With this resumé of behavior in *Tetragoneuria* as background and before turning to additional cases in Odonata it would be well to review briefly the concept of territorial behavior. Carpenter (1958) has noted that the many definitions of terrioriality which have been advanced are based largely on bird behavior and do not represent the complete range of variability of most species; even with respect to vertebrates other than birds concepts are deficient in descriptions of main characteristics and variations of territorial behavior. He suggests that it be viewed as a complex behavioral system based on a plurality of subsystems and expressed in a spatial-temporal frame of reference. If territoriality is a behavioral system of broad spectrum, then several corollaries appear to follow: (1) study of its expression will not be easy; (2) constancy of its expression from group to group or in individuals of a given group can not be anticipated; (3) uniqueness of biological significance or function may not be served.

The classical concepts and historical development of territoriality have been summarized in the well-known papers by Nice (1933, 1941). Based on bird behavior, the central reactions or requisite behavior according to Nice (1941) appear to be the following: (1) spacing of pairs through pugnacity of males towards others of their own species and sex; (2) use of signals to warn away other males and to attract females; (3) fighting of males primarily for territory and not for mates; and (4) superiority and/or near invincibility of a male within his own territory. Discussion of the validity of these conditions for territoriality for all animals is beyond the scope of this paper. More information obtains on the spacing and signalling components in Odonata; however, Jacobs (1955) has shown that a territorial male dragonfly shows superiority in a number of ways. Superiority, however, seems to be more a concomitant than condition of territorial behavior since it appears to be a result of greater familiarity of the occupant with his peculiar area.

Although the literature on Odonata contains frequent references to spacing, localization and territorial behavior, the

systematic and critical investigation of one or more of these phenomena has been limited to the studies by Borror (1934), St. Quentin (1934), Moore (1952), Jacobs (1955), and Kormondy (1959). The latter four of these papers serve as the basis for determining the expression of territoriality in Odonata.

With respect to spacing, Moore (1953) found that the length of beat of solitary male dragonflies varies from more than 8 and up to 170 yards. When more individuals were present, the minimum spacing was 13 dragonflies per 100 yards (8 yards per dragonfly), irrespective of the number of species present. At peak population density in *Tetragoneuria* the minimum spacing was 3 to 10 yards, whereas when only solitary individuals were flying, the length of beat was as much as 50 to 100 yards. Dependence of the degree of spacing on population density has been recognized in other studies. That spacing behavior is an aspect of and is regulated by reproductive behavior is proposed by Moore and supported by my studies on *Tetragoneuria.* Spacing has no obligate relationship to localization, i.e., the constancy of association of a given male with a given area. Borror, for example, found a high degree of localization but no spacing to be characteristic of *Argia moesta, Hetaerina americana* and *Argia sedula;* Moore reported spacing but very little or no localization in the several species he studied. On the other hand, Jacobs reported that *Plathemis lydia* showed spacing and definite localization to specific sectors of the study area; many individuals returned to sectors previously occupied after having been absent for as long as five days. Apparent localization in *Tetragoneuria* can as well be interpreted as being fortuitous since the data are so meagre. Concern with the duration of localization as a prerequisite for postulating territoriality however, seems to be of less value than deciphering interactional behavior of males in localized areas.

With respect to interactions occurring intra- and interspecifically in spaced dragonflies, behavior in no small measure appears to be modulated by the discriminatory ability of the occupant dragonfly. Using tethered individuals of seven species Moore showed that there is a greater ability to distinguish kind than sex in species which are not strongly dimorphic. The vast majority of potential interspecific miscegenations never passed

what Moore termed the "approach" stage, whereas intraspecific male clashes were rather the rule. It appears from his data that the highest frequency of intraspecific clashes occurred where significant morphological differences between the sexes are lacking. Erroneous attacks of either an inter- or intraspecific nature may occur in animals in a heightened state, according to Tinbergen (1953), if the foreign species or other male presents a stimulus which normally triggers the attack reaction.

With regard to signalling as a means of deterring other males and/or attracting females, the data are such that we cannot determine the innate and learned components and reactions. Jacobs has shown that in *Plathemis lydia*, a sexually dimorphic species, signalling among males is by dashes at one another, pursuit displays and dual flights, whereas in *Perithemis tenera*, also a sexually dimorphic species, it is effected by wing fluttering and pursuit flights. In the non-sexually dimorphic *Tetragoneuria*, males appear to learn to avoid occupied areas the signal being the mere presence of the occupant male. Moore concluded that individuals learn to avoid sites of previous encounters with rival males which they cannot distinguish from females. In any event, whether the signal is by chase, challenge, display, or mere presence, innate or learned, elimination of males from the inmediate occupied area occurs.

Three major functions of territoriality in Odonata have been proposed: (1) to provide the male with a hunting (i.e., feeding) ground; (2) to serve in sexual selection and isolation; (3) to aid in dispersal. The first point was advanced by St. Quentin in his concept of the "Jagdrevier"; however, available evidence indicates that the primary reason for many or most dragonflies being at the water is mating. It is true that crepuscular aeshnines and certain cordulines feed over water on swarming mayflies; however, the characteristics of this feeding flight are quite different from those involved during reproductive flight. Regarding the second function, Williamson (1906) postulated, without critical evidence, that intraspecific male conflict may lead to sexual isolation, a point verified by my work in *Tetragoneuria;* Jacobs has shown experimentally the role of territory in sexual selection in *Plathemis lydia* and *Perithemis tenera.*

DISPERSAL

Moore proposed that spacing of individuals, which is dispersal in the breeding area, leads to dispersal of some individuals away from the breeding area. This point is probably the most difficult to establish experimentally or observationally. Marking-recapture or marking-sighting studies, of admitted limited application and success, appear to be the only practical methods available at the moment. In consequence, this section is more speculative, consisting largely of hypotheses hopefully provoking criticism and future study.

It was stated above that the amount of spacing varies directly with population density but has a minimum range; when this minimum is approximated or reached the area is, as it were, saturated. At this point incoming males cannot be accommodated but must leave the area. It is not known if they disperse in a density related fashion as proposed by Bovbjerg (1959) for animals demonstrating intraspecific aggressive behavior.

Possible attributes of dispersal as a function of territoriality may be considered in several major categories: (1) preventing or lessening interference of a male with an ovipositing female; (2) avoiding overcrowding of a restricted breeding area; (3) populating newly opened or reopened areas. If species copulate away from the water, as do those which Moore studied, limited spatial dispersal is not the means of preventing interference in copulation, but the flight away is. Jacobs argues that since territorial behavior reduces the potential number of males at the breeding area, potential interference with oviposition is thereby removed. Jacobs also shows that in situations in which the male holds the female during oviposition, as in *Enallagma aspersum,* there is no territorial behavior.

In preventing overcrowding of the restricted breeding area, dispersal may affect the adult by preventing a further increase in adults before density-dependent mortality factors could act on population size. By promoting more uniform occupancy of local fragments of the environment there is an increased likelihood that a coursing female would be mated with. If the territory includes the oviposition site, as in *Plathemis* and *Perithemis,* one concomitant might be a lessening of potential larval density;

if the oviposition site is outside the mating territory, as in *Tetragoneuria,* this function could hardly be served. In fact, any benefit of spacing in potentially preventing overcrowding of larvae is controverted by aggregational oviposition behavior in *Tetragoneuria.* Possibly the major factor resulting from territorial induced dispersal occurs through the exclusion of some males from the breeding area inasmuch as this not only samples the gene pool but does so in a small interbreeding population.

Dispersal in the broader sense is the means of populating newly available or reopened areas, but the role of territoriality in this phenomenon is essentially unstudied. A major deficiency in evidence of such factors as incidence, rates, and directions of Odonata population movements is also acknowledged. Wolfenberger (1946) shows that as one proceeds out of a center of dispersion not only does the number of insects drop off rapidly, but those which continue to disperse do so at a less rapid rate of movement. His evidence also indicates that dispersion occurs over greater distances where populations at the origin are denser. Although there is no evidence available in Odonata to apply directly here, it is noted that spacing behavior is largely known to occur in libellulines, the group to which belong most migrant species.

The common assumption that Odonata are readily dispersed appears to be based in no small measure on the strong flight powers of many of its members, and/or on the light-bodied damselflies which should be easily dispersed by wind, updrafts, and currents. That they are not so readily dispersed appears to be borne out by several lines of work, the former by records of migratory and/or swarming species and the localization studies discussed above, and the latter by studies on the distribution of Odonata in and by the air. Regarding the latter point Glick (1939) reported twenty-one Odonata taken at altitudes of 20 to 3000 feet (only one Zygoptera at the latter height), with only seven species (four Anisoptera, three Zygoptera) represented. No strong fliers were taken over 1000 feet although some were observed as high as 7000 feet. On the other hand, the widely distributed *Anomalagrion hastatum* (Say), one of the smallest and weakest Zygoptera, was relatively the most abundant form in the upper air. Although it would seem reasonable that light-

bodied forms might be updrafted and dispersed by wind action, very few were; it seems equally unlikely that strong fliers would be so affected. Glick's totals are, unfortunately, too small to serve as any more than speculative spring-boards. Felt (1928), in summarizing dispersal of insects by air currents, concluded that dispersal of such large forms as species of *Anax, Aeshna* and *Tramea* is due more to their inherent ability to remain in the air for considerable periods than as a result of wind currents.

Although migratory species have been reported among calopterygines, agrionines, aeshnines and libellulines, it cannot be said that migratory behavior is widespread in Odonata. Of some 5000 known species, probably less than 25 to 50 are known to be migratory. Williams (1958), mentions 13 migrant species of Odonata. The British Isles, for example, have been invaded on numerous occasions but the species involved have been few. One of the most extensive recent migrations occurred in 1947 and involved *Sympetrum striolatum nigrifemur* apparently from the coast of Spain and Portugal (Longfield, 1948).

In North America, the reported migrants seem to be: *Aeshna clepsydra,* attributed by Brown to have annual migrations in Wisconsin (Calvert, 1893); *Anax junius, Libellula pulchella* and *Tramea lacerata* which, according to Shannon (1916), follow regular annual migration routes along the Atlantic Coast similar to those of birds and involving as many as 360,000 individuals (in this connection, *Anax junius* and *Tramea lacerata* were reported by Borror (1953) as constituting 90% of a migratory flight on Long Island); *Pantala flavescens* and *Tramea carolina,* which along with *Anax junius* have a definite migration for the purpose of obtaining food (Wright, 1945). Walker (1953), however, states: "We know of no reports of dragonfly migrations in Canada, although the occurrence of swarms of certain species is no rarity." I have elsewhere (1959) reported on four swarms of 50 to 100 individuals involving the three northern species of *Tetragoneuria* with six other species. Whether swarming is related to migratory behavior is unknown; the most noted migrant, *Libellula quadrimaculata,* however, is widely distributed and is frequently observed in swarms. In sum, migratory behavior is an activity pattern limited to few species. Although it may be a mechanism of dispersal for these forms, regularly for some

and occasionally for others, migration does not seem to be the mode of dispersal for many. Further, what relationship obtains between migratory and territorial behavior is yet to be determined.

The preceding discussion has centered largely on the general nature of territoriality in Odonata with rather less detail on the role of this behavior in dispersal. This has been occasioned by the lack of systematic and quantitative data on dispersal, or on dispersal as an effect of territoriality. Considerably more needs to be learned of the range of expression of territorial behavior in Odonata, as well as in other invertebrates, and certainly much more needs to be learned of dispersal incidence, rates, direction, and associated factors. We are, it seems, still largely in the stage of knowing that certain dragonflies occur here and there, but have no valid data to indicate how they got from here to there. Two things we do seem to know: (1) that as far as the individual is concerned the tendency to react to a particular set of landmarks is a deterrent to dispersal, (2) that as far as the population is concerned, territoriality deters some individuals from moving and necessitates the movement of others.

SUMMARY

1. Territorial behavior in Odonata is reviewed with emphasis on spacing and signalling.
2. In Odonata (and other organisms), territoriality may function in sexual selection and in aiding dispersal. Dispersal is presumably significant in avoiding overcrowding effects in a restricted breeding area, lessening interference with oviposition, and populating newly opened or reopened areas.
3. The possibility of relationship between migration and/or swarming and territoriality is considered.

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BOOK REVIEW

Cydnidae of the Western Hemisphere by Richard C. Froeschner Proceedings of the United States National Museum, Smithsonian Institution, Washington D.C. No. 3430, vol. 111, pp. 337–680, 300 figures. 1960.

American hemipterists have avidly been awaiting the appearance of this comprehensive revision of the burrowing bugs of the New World. It is a masterful treatment, by a master hemipterist, of a group of insects which have, far too long, been neglected in the general study of the Pentatomoidea. After the introduction and review of the literature, Froeschner gives a concise, but thoroughly adequate, digest of the important morphological characteristics that are used in the taxonomic analysis. It is pleasing to note that new emphasis is placed on the importance of the trichobothria in classification; these are, more and more, coming into prominence in taxonomic work. In the systematic section of the monograph two new subfamilies, the Garsauriinae and Scaptocorinae are erected, and the tribe Amestini is elevated in rank to subfamily (Amestinae) status. A complete synonomy of each genus and species is given along with a redescription (except in the cases of new genera and species) of both male and female individuals; type data and the repository of the type or type series is included; new distributional data are added, and detailed notes and comments on habits, variation, etc., add to the completeness of the work. The value of the monograph is greatly enhanced by sixteen beautiful carbon-dust drawings made by Mrs. Froeschner and by 284 clear cut line drawings showing the detailed structures used in generic and specific differentiation. All this is the most comprehensive treatment of a group of insects that one could ask for, and it is our fond hope that Dr. Froeschner will continue his researches and soon turn his attention to as thorough revisions of other families of the heteroptera.

HERBERT RUCKES

AN ANNOTATED LIST OF THE LYCAENIDAE (LEPIDOPTERA: RHOPALOCERA) OF THE WESTERN HEMISPHERE

By William Phillips Comstock and Edgar Irving Huntington

[Continued]

jactator Druce, Hamilton H., *Thecla*
Type Locality: Paraguay.
Location of Type: Druce Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 587, pl. 34, fig. 9 ♂ (London).

jada Hewitson, W. C., *Thecla*
Type Locality: Mexico.
Location of Type: British Museum (Natural History)?
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 87, vol. 2, pl. 34, figs. 67, 68 ♂ (London).

jago Comstock, W. P. and E. I. Huntington, *Thecla simaethis*
Type Locality: Dunrobin District, Mandeville, Manchester, Jamaica, B. W. I., January.
Location of Type: American Museum of Natural History.
Original Description: 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 74, pl. 1, fig. 7 ♀ (New York).

jalan Reakirt, Tryon, *Thecla*
Type Locality: Near Vera Cruz, Mexico (♀).
Location of Type:
Original Description: 1866 (November), Proc. Acad. Nat. Sci. Philadelphia, p. 337 (Philadelphia, Pa.).
Additional Reference: Draudt, Max, 1919 (November), The Macrolepidoptera of the World, vol. 5, p. 752 (Stuttgart). (Makes *jalan* a synonym of *aufidena* Hewitson incorrectly and makes *aufidena* a subspecies of *battus* Cramer.)
Synonyms: *aufidena* Hewitson.

jambe Draudt, Max, *Thecla* (not Godman and Salvin) See *iambe* Godman and Salvin
Type Locality:
Location of Type:
Original Description: 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 802, pl. 158-1 (Stuttgart).

janais Hewitson, W. C., *Thecla* (not Cramer) Misspelling of *janias* Cramer

Type Locality:
Location of Type:
Original Description: 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 202 (London).

janias Cramer, Pierre, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1779, Papillons exotiques des trois parties du monde, vol. 3, p. 36, pl. 213, figs. D, E (Amsterdam).
Additional Reference: Godman, F. D. and O. Salvin, 1887 (May), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 35, vol. 3, pl. 52, fig. 15 ♂ (London).
Synonyms: *janais* Hewitson, *cecina* Hewitson, *hassan* Stoll.

janthina Hewitson, W. C., *Thecla*
Type Locality: Vera Paz, Guatemala.
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 93, vol. 2, pl. 37, figs. 104, 105 ♂ (London).
Subspecies: *venezuelae* Lathy.

janthodonia Dyar, Harrison G., *Thecla*
Type Locality: Santa Rosa, V. C., Mexico, August, 1906.
Location of Type: United States National Museum, no. 21, 202.
Original Description: 1919, Proc. U. S. Natl. Mus., vol. 54, p. 337 (Washington, D. C.).

japola Jones, E. Dukinfield, *Thecla*
Type Locality: Castro, Paraná, Brazil.
Location of Type: Jones Collection.
Original Description: 1912, Proc. Zool. Soc. London, p. 898, pl. 97, fig. 6 (London).

jebus Godart, Jean B., *Polyommatus*
Type Locality: Brazil.
Location of Type:
Original Description: 1822, Encyclopédie Méthodique, vol. 9, p. 639 (Paris).
Additional References: Geyer, Carl *in* Hübner, 1835, Sammlung exotischer Schmetterlinge, vol. 3, pl. (19) (Augsburg), as *Sithon jebus* from "Cayana". Godman, F. D. and O. Salvin, 1887 (June), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 42, vol. 3, pl. 53, figs. 5, 6 ♂, 7 ♀ (London).

jemezensis Gunder, Jean D., *Everes comyntas herrii* tr. f.
Type Locality: Jemez Springs, New Mexico, May 13, 1913.
Location of Type: Academy of Natural Sciences, Philadelphia, Pennsylvania.
Original Description: 1927 (December), Can. Ent., vol. 59, p. 284, pl. A, fig. 11 (Orillia, Ont.).

Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 27, no. 447 (Los Angeles, Calif.). (Places *jemezensis* as an aberration of *herrii* Grinnell.)

jeneirica Felder, Cajetan, *Thecla beon* var.
Type Locality: Rio de Janeiro, Brazil.
Location of Type:
Original Description: 1862, Verh. Zool.-Bot. Ges., vol. 12, p. 474 (Wien).
Additional Reference: Draudt, Max, 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 795 (Stuttgart). (Places *jeneirica* in the synonymy of *beon* Cramer.)

joannisi Dufrane, Abel, *Thecla davara*
Type Locality: Trujillo, Peru.
Location of Type:
Original Description: 1939 (August), Bull. and Ann. Soc. Ent. Belgigue, vol. 79, p. 290.

johnsoni Skinner, Henry, *Thecla*
Type Locality: Seattle, Washington, July 15, 1891; British Columbia, female type.
Location of Type: Academy of Natural Sciences, Philadelphia, Pennsylvania.
Original Description: 1904 (November), Ent. News, vol. 15, p. 298 (Philadelphia, Pa.).

joya Dognin, Paul, *Thecla*
Type Locality: Loja, Ecuador.
Location of Type:
Original Description: 1895, Ann. Soc. Ent. Belgigue, vol. 39, p. 106 (Bruxelles).
Synonyms: *callao* Druce.

juanita Scudder, Samuel H., *Thecla*
Type Locality: Pilatka, Florida, February 10.
Location of Type:
Original Description: 1868 (May), Proc. Boston Soc. Nat. Hist., vol. 11, p. 435 (Boston, Mass.).
Additional Reference: Draudt, Max, 1919 (November), The Macrolepidoptera of the World, vol. 5, p. 750 (Stuttgart). (Makes *juanita* northern race of *halesus* Cramer. This is incorrect and *juanita* is merely a synonym of *halesus*.)

juica, *Thecla* Misspelling of *juicha* Reakirt
Type Locality:
Location of Type:
Original Description: 1867, Zool. Record, vol. 3, p. 470 (London).

juicha Reakirt, Tryon, *Thecla*
Type Locality: Near Vera Cruz, Mexico.
Location of Type:

Original Description: 1866 (November), Proc. Acad. Nat. Sci. Philadelphia, p. 338 (Philadelphia, Pa.).
Additional Reference: Draudt, Max, 1919 (December), The Macrolepidoptera of the World, vol. 5, p. 761 (Stuttgart). (Makes *juicha* a synonym of *palegon* Cramer.)
Synonyms: *juica* (Zool. Record).

juniperaria Comstock, John A., *Mitoura siva*
Type Locality: Mint Canyon, Sierra Madre Mountains, California.
Location of Type: Southwest Museum?
Original Description: 1925, Bull. Southern Calif., Acad. Sci., vol. 24, pt. 2, p. 37, figs. (Los Angeles, Calif.).

kali Strecker, Herman, *Thecla*
Type Locality: Arizona.
Location of Type: Strecker Collection (1 ♂).
Original Description: 1877 (November), Lepidoptera, Rhopaloceres and Heteroceres, p. 129 (Reading, Pa.).
Additional Reference: Dyar, Harrison G., 1902, Bull. U. S. Natl. Mus., no. 52, p. 39, no. 370 (Washington, D. C.). (Places *kali* as a synonym of *behrii* Edwards.)

kalikimaka Clench, Harry K., *Thecla*
Type Locality: Jalapa, Mexico.
Location of Type: Museum of Comparative Zoology, no. 26, 257.
Original Description: 1944 (September), Jour. New York Ent. Soc., vol. 52, p. 258 (New York).

keila Hewitson, W. C., *Thecla*
Type Locality: Guatemala (Polochic Valley).
Location of Type: British Museum (Natural History).
Original Description: 1869 (April), Illus. of Diurnal Lepidoptera, vol. 1, p. 121, vol. 2, pl. 52, figs. 280, 281 ♂ (London).
Additional Reference: Godman, F. D. and O. Salvin, 1887 (August), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 50, vol. 3, pl. 54, figs. 7, 8 ♂, 9 ♀ (London). (Say "Hewitson's figures of this insect are very unsatisfactory, the peculiarities of the cellular brand being very inadequately rendered.")
Synonyms: *parasia* Hewitson.

kelseyi Wright, W. S., *Plebejus acmon* ab.
Type Locality: San Diego County, California.
Location of Type: San Diego Society of Natural History.
Original Description: 1930, Trans. San Diego Soc. Nat. Hist., vol. 6, p. 29 (San Diego, Calif.).

kingi Klots, Alexander B. and Harry K. Clench, *Strymon*
Type Locality: Savannah, Georgia, May 16, 1949, May 24, 1951.
Location of Type: American Museum of Natural History.
Original Description: 1952 (December), Amer. Mus. Novitates, no. 1600, p. 1, figs. 1–3 (New York, N. Y.).

klotsi Field, William D., *Lycaena heteronea*
Type Locality: Broadwater County, Montana, July 30, 1930.
Location of Type: W. D. Field Collection.
Original Description: 1936 (May), Ent. News, vol. 47, no. 5, p. 123 (Philadelphia, Pa.).

koá Druce, Herbert, *Lycaena*
Type Locality: Pozzuzo, Peru.
Location of Type: British Museum (Natural History).
Original Description: 1876, Proc. Zool. Soc. London, p. 239, pl. 18, fig. 7 (underside) (London).

kodiak Edwards, William H., *Lycaena*
Type Locality: "Kodiak" (1 ♂, 1 ♀).
Location of Type:
Original Description: 1870 (January), Trans. Amer. Ent. Soc., vol. 3, p. 20 (Philadelphia, Pa.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 27, no. 449 (Los Angeles, Calif.). (Places *kodiak* as a subspecies of *scudderii* Edwards.)

kohlsaati Gunder, Jean D., *Plebeius aquilo* tr. f.
Type Locality: Mount McKinley National Park, Alaska, July 29, 1930.
Location of Type: American Museum of Natural History.
Original Description: 1932, Pan-Pacific Ent., vol. 8, no. 3, p. 127 (San Francisco, Calif.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 27, no. 452 (Los Angeles, Calif.). (Places *kohlsaati* as an aberration of *aquilo* Boisduval.)

kuscheli Ureta R., Emilio, *Thecla*
Type Locality: Larancagua, Chile, December 9, 1946, 2800 m. (male), Larancagua, February 25, 1948 (female).
Location of Type: Museo Nacional de Historia Natural, Santiago, Chile.
Original Description: 1949, Boletín del Museo Nacional de Historia Natural, vol. 24, p. 98, pl. 1, fig. 4 (Santiago, Chile).

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ENZYMES IN THE HEMOLYMPH OF THE MEALWORM, *TENEBRIO MOLITOR* LINNAEUS[1]

By Carl D. Prota

Department of Biology, Fordham University[2]

Relatively little work has been done on the enzymes of insect hemolypmh, probably because of the small volume available for a single experiment. Faulkner (1956) has shown that silkworm hemolymph contains malic enzyme (a triphosphopyridine nucleotide linked dehydrogenase) and malic dehydrogenase (a diphosphopyridine nucleotide linked dehydrogenase) which oxidize malate. He was also able to show the reversibility of the malic enzyme. All workers agree that hemolymph darkens on exposure to air, and that this reaction is probably due to the action of tyrosinase. Ito (1954) noted from in vitro studies on the fresh hemolymph of the silkworm, *Bombyx mori,* that tyrosinase activity varies notably during development. He found its activity to be low in early, and at a maximum in late metamorphosis. Catalase was found by Matsumura (1935) to be active in the hemolymph of this insect. It is more active in males than in females, particularly after the fourth molt.

To the author's knowledge no information is available concerning the enzymes found in the insect hemolymph other than those

[1] From a thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Fordham University. The author wishes to express sincerest gratitude for the stimulation, interest and guidance of Dr. Daniel Ludwig.

[2] Author's present address: Research Facility, Rockland State Hospital, Orangeburg, New York.

mentioned above. The present work was therefore undertaken to investigate the enzyme activities of the hemolymph of the mealworm, *Tenebrio molitor,* and their changes during metamorphosis.

MATERIAL AND METHODS

The mealworms were reared in chick growing mash at room temperature (approximately 25° C). Hemolymph was obtained by first etherizing the insect for 20 minutes to prevent coagulation, then a leg or an antenna was cut and the hemolymph was allowed to drop into a depression of a spot plate. In obtaining blood from the adult, it was found best to cut the tip of the abdomen. In each experiment a 0.2 ml. sample was used. The determination of rates of enzyme action were confined to larval and adult hemolymph, since during metamorphosis the hemolymph contained much debris due to the breakdown of larval tissues and results become inconsistent. In each case, a minimum of 10 determinations were made on larval hemolymph and 5 on that of the adult. Blood was used as a tissue, no attempt being made to separate the constituent elements.

The activities of malic, isocitric, alcohol, glutamic, alpha-glycerophosphate, glucose, and lactic dehydrogenases, xanthine oxidase, malic enzyme, uricase, and cytochcrome oxidase were measured spectrophotometrically. Determinations were made using the Beckman DU spectrophotometer. In each experiment the instrument was set at zero with a control containing inactivated hemolymph (inactivated by boiling) and all materials found in the reaction mixture, with the exception that in the determination of cytochcrome oxidase, 0.03 M phosphate buffer was used to zero the spectrophotometer. The coenzyme requirements for the dehydrogenases studied are given by Ludwig and Barsa (1958). Succinic, malic, isocitric, glutamic, alpha-glycerophosphate, glucose, and lactic dehydrogenases and xanthine oxidase were measured by the method of Thunberg which depends on the rate of decoloration of methylene blue as the substrate is being oxidized (Umbreit, Burris, and Stauffer, 1945). In all determinations with each technique, the mixture was allowed to incubate for 30 minutes to insure the oxidation of endogenous material before adding substrate. Diphosphopyridine nucleotide or triphosphopyridine nucleotide was used except with succinic

dehydrogenase and xanthine oxidase where no coenzyme was necessary.

Xanthine oxidase was measured by the method of Horecker and Heppel (1949). This procedure is based on the rate of appearance of the reduced band of cytochrome *c* at 5500 A. U. when cytochrome *c* is reduced by the oxidation of hypoxanthine in the presence of xanthine oxidase. In each test corex cuvette, were placed 0.4 ml. of 0.1 M phosphate buffer at a pH of 7.4, 2 ml. of Sigma cytochrome *c* (5 mg./10 ml. buffer) prepared from horse heart, 0.1 ml. of catalase (used to prevent the reoxidation of cytochrome *c*), 0.1 ml. of bovine albumin (used to bind the protein present) and 0.2 ml. of blood. Readings were taken at 1 minute intervals for 5 minutes after the addition of 0.2 ml. of 0.05 M hypoxanthine. After 5 minutes a final reading was made upon the addition of 1 mg. of solid sodium hydrosulfite to completely reduce the cytochrome *c*. The reduction of cytochrome *c* was calculated from the formula given by Horecker and Heppel.

Cytochrome oxidase activity was measured by the method of Cooperstein and Lazarow (1951). This method is based on the oxidation of reduced cytochrome *c* at a wave length of 5500 A. U. by cytochrome oxidase. The cytochrome *c* was prepared in 0.03 M phosphate buffer at a pH of 7.4 by adding 5 mg. of Sigma cytochrome *c* to each 10 ml. of solution. It was then reduced by the addition of a few crystals of sodium hydrosulfite, the excess reducing agent being removed by bubbling air through the solution for about 15 minutes. In making a determination on the activity of cytochrome oxidase, 2.5 ml. of reduced cytochrome *c* were mixed with 0.2 ml. of blood, and 0.3 ml. of phosphate buffer at a pH of 7.4 in a Beckman cuvette. The first reading on the density of the mixture was made within 1 minute after the addition of the blood to the cytochrome *c*, and readings were made at intervals of 1 minute for a period of five minutes. At the end of that time, 0.1 ml. of M/10 potassium ferricyanide was added to the reaction mixture cuvette, mixed by inversion, and a reading made of the optical density of the oxidized cytochrome *c*. Calculations were made of cytochrome oxidase activity using the formula given by Cooperstein and Lazarow.

Uricase was measured by the method of Kalcker (1947). It consisted of measuring the change in optical density at 2900

A. U. as uric acid is converted to allantoin. In each determination, 3ml. of reaction mixture consisting of 1.8 ml. of substrate, 1.0 ml. of borate buffer at a pH of 9.2, and 0.2 ml. of blood were employed in the test silica cuvette.

The activities of the diphosphopyridine nucleotide (DPN) and triphosphopyridine nucleotide (TPN) linked enzymes were measured by a variation of the method of Faulkner (1956). They were measured at 3400 A. U. using silica cuvettes. The reaction mixtures contained 0.25 ml. of 0.2 per cent DPN or 0.25 ml. of 0.1 per cent TPN, 0.2 ml. of 0.25 M substrate and enough 0.03 M phosphate buffer to bring the total volume to 3 ml. In measuring isocitric dehydrogenase activity, 0.25 ml. of 6×10^{-3} M $MnCl_2$ solution, and for malic enzyme, 0.25 ml. of 0.033 M $MgSO_4$ was added to the reaction mixture. These ions are necessary for the maximal reactions to take place (Ochoa, Mehler, and Kornberg 1948). For malic dehydrogenase, 0.25 ml. of KCN was added to the reaction mixture to prevent inhibition of the enzyme by the oxaloacetate formed (Green 1936). DPN is required for malic, alcohol, glutamic, alpha-glycerophosphate, glucose, and lactic dehydrogenases, and TPN for the malic enzyme and isocitric dehydrogenase (Ludwig and Barsa 1958).

The Thunberg technique involved the use of the same reaction mixtures as were required for the spectrophotometric method. In the cap of the Thunberg tube were placed the reaction mixture and 0.2 ml. of previously incubated blood. In the body of the tube were placed 0.5 ml. of 1/10,000 per cent methylene blue, 0.5 ml. of 0.25 M substrate and enough buffer to give a final total volume of 3 ml. The tube was then evacuated, and the cap rotated to close the tube. The control Thunberg tube contained all the reactants except substrate and was used to show changes in the reaction tube produced with a known amount of added substrate. A standard tube was prepared which contained all of the reactants except that the methylene blue was diluted to 1/10 of the usual concentration before being added and the blood inactivated by boiling. The standard represents 90 per cent reduction of methylene blue. All the tubes were incubated in a water bath at 30° C. until the control and reaction mixture reached the color of the standard.

OBSERVATIONS

Spectrophotometric measurements showed no activities for

cytochcrome oxidase, uricase, or alcohol dehydrogenase in either larval or adult hemolymph. Furthermore, with this procedure, no activities were found for glutamic, alpha-glycerophosphate, glucose or lactic dehydrogenases in larval hemolymph, but positive results were found in that of the adult. Malic and isocitric dehydrogenases and the malic enzyme were active in the hemolymph of both stages. These activity values, are shown in Table I. Furthermore, xanthine oxidase was present in the

TABLE I.

Spectrophotometric determinations of enzyme activities in the hemolymph of the larvae and adult mealworm. Activities are expressed as a change in density units during 30 minutes as DPN or TPN is reduced by the oxidation of substrate. Readings were made at 3400 A. U.

Enzyme	Stage	
	Larva	Adult
	DPN linked dehydrogenases	
Glutamic	—	0.134
Alpha-glycerophosphate	—	0.092
Glucose	—	0.072
Lactic	—	0.139
Malic	0.029	0.099
	TPN linked dehydrogenases	
Malic enzyme	0.222	0.416
Isocitric	0.477	0.324

hemolymph from both larva and adult, its activities expressed as $\triangle$ log [Cy Fe^{++}]/minute, were 0.067 for adult and 0.025 for larva.

The Thunberg method failed to show activities for alcohol or succinic dehydrogenases in the hemolymph of either stage. Xanthine oxidase was found to be more than twice as active in the adult hemolymph than that of the larva with this method. Activity values, expressed as 1/time in minutes for 90 per cent reduction of methylene blue, being 0.057 and 0.024, respectively. The activities of the DPN linked enzymes are shown in Table II. As with the spectrophotometric method, except for malic dehydrogenase, no activities were found for these enzymes in larval hemolymph. By this technique, malic dehydrogenase was also found to be more active in the adult than in the larva. With

TABLE II.

Activities of the DPN linked enzymes of the larval and adult hemolymph. Activities are expressed as 1/time in minutes for 90 per cent decoloration of methylene blue.

Substrate	Larva (Control) Blood + DPN No Substrate	Larva Blood + TPN + Substrate	Larva Enzyme Activity	Adult (Control) TPN Blood + No Substrate	Adult Blood + DPN Substrate	Adult Enzyme Activity
Sodium malate	0.006	0.013	0.007	0.007	0.019	0.012
L-glutamic acid	0.003	0.003	—	0.004	0.006	0.002
Sodium alpha-glycero-phosphate	0.003	0.003	—	0.005	0.008	0.003
Sodium lactate	0.003	0.003	—	0.004	0.007	0.003

this method lactic was less active than malic dehydrogenase, whereas with the spectrophotometric method the reverse was true. The activities for the TPN linked enzymes are shown in Table III. With the Thunberg method, the activities of both

TABLE III.

Activities of the TPN linked enzymes of the larval and adult hemolymph. Activities are expressed as 1/time in minutes for 90 per cent decoloration of methylene blue.

Substrate	Larva (Control) Blood + TPN No Substrate	Larva Blood + DPN + Substrate	Larva Enzyme Activity	Adult (Control) Blood + TPN No Substrate	Adult Blood + TPN Substrate	Adult Enzyme Activity
Sodium malate	0.019	0.038	0.019	0.013	0.034	0.021
Sodium isocitrate	0.004	0.061	0.057	0.003	0.033	0.030

malic and isocitric dehydrogenase of adult blood are almost the same; whereas with the spectrophotometric method (Table I), malic enzyme was more active than isocitric dehydrogenase in this stage.

DISCUSSION

The failure of lactic acid accumulation under aerobic conditions

is due to the rapid oxidation of pyruvate in the presence of oxygen by way of the tricarboxylic acid cycle of which isocitric and malic dehydrogenases are a part. Since these dehydrogenases are present in the hemolymph of both stages it would be reasonable to assume that at least part of the tricarboxylic acid cycle is present. On the other hand, the absence of the succinoxidase system, which includes succinic dehydrogenase and cytochrome oxidase, in the hemolymph of both stages, indicates the oxidations may be completed somewhere else or that the terminal hydrogen transfer system may be a flavoprotein. In the latter case, peroxides would be formed and catalase would be required. Glucose, glutamic, alpha-glycerophosphate, and lactic dehydrogenases are concerned in anaerobic glycolysis. It appears that the hemolymph of the adult is more active in these metabolic processes than that of the larva. In adult hemolymph, the number of enzymes concerned with both glycolysis and the tricarboxylic acid cycle exceeded those found in larval hemolymph. This observation indicates that intermediate metabolism may be more complete in the hemolymph of the adult. Faulkner (1956) was able to demonstrate the malic enzyme in the hemolymph of the silkworm, *B. mori.* In his paper, Faulkner postulated that the malic enzyme in insect blood helps to maintain the ionic balance, and may take some part in the control of the redox potential of the blood. The results of the present paper agree in part with those of Faulkner, but the rate of action of the malic enzyme was found to be slower in mealworm blood than in that of the silkworm. This difference in rate may be associated with the greater purity of the preparation used by Faulkner since he used dialyzed blood. The activity of the malic enzyme in converting malate to pyruvate was one of the highest found in mealworm blood.

Since xanthine oxidase is widespread throughout insect tissues, it is not surprising to find this enzyme in the hemolymph. Ludwig and Cullen (1956) have found a high content of uric acid and allantoin in insect blood. A high content of uric acid was also reported in hemolymph of various insects by Buck (1953). It may indicate that a site of action of xanthine oxidase is the hemolymph, since this enzyme oxidizes hypoxanthine and xanthine to uric acid. On the other hand, the absence of uricase activity (which oxidizes uric acid to allantoin) in the blood may

indicate that allantoin is formed elsewhere and released into the blood.

The discrepancy observed for the different higher activity rates of the Thunberg and the spectrophotometric methods, may be associated with the two different techniques employed for their determination. In the former at least two reactions are involved, the reduction of DPN or TPN, and the transfer of hydrogen to methyl blue, whereas the latter method measured only the reduction of the coenzymes.

SUMMARY

1. The activities of enzymes in the hemolymph of the mealworm, *T. molitor* were studied in the larval and adult stages by the spectrophotometric method and the Thunberg technique.

2. No activities were obtained for cytochrome oxidase, uricase, succinic and alcohol dehydrogenases in either the larval or adult hemolymph by either method.

3. Xanthine oxidase, measured by the Thunberg method, was found to be active in both larval and adult hemolymph.

4. With both methods it was found that glutamic, alpha-glycerophosphate, glucose, and lactic dehydrogenases, which require DPN were absent in larval hemolymph but present in that of the adult. Malic dehydrogenase was present in both stages.

5. With each method malic enzyme and isocitric dehydrogenase, which require TPN, showed high activities in both larval and adult hemolymph.

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NOTES ON THE DISTRIBUTION AND HABITAT OF CHILOSTIGMA AREOLATUM (WALKER) IN MANITOBA (TRICHOPTERA: LIMNEPHILIDAE)

By Walter V. Krivda
Thalberg North, Manitoba

Recently in sorting the pinned Manitoban Trichoptera in my collection it was found that sufficient material was at hand to warrant a short note on the species in Manitoba.

There is little in the literature about *Chilostigma areolatum,* though it is apparently widely distributed. Apparently nothing is known of its biology. Since 1949 when the species was first noted at The Pas, Manitoba, it has been searched for each spring. My first encounter with the species was in the spring of 1949 when it was noted flying over a roadside ditch in early April—one mile north of The Pas. The species occurs along the edges of sphagnum bogs very early in the spring, frequently when snowdrifts still lie one to two feet deep in shaded spruce woods. The insects are easily captured as the flight is delicate and weak and they themselves visible against the background of the snow. They frequently settle on the snow and fold their wings in the manner usual in Trichoptera. In one instance, April 1953, at The Pas, the species occurred in considerable numbers at dusk along a roadside ditch bordering a sphagnum bog. When alarmed, they can rise thirty feet flying into spruce trees in the bog. They can be simply flushed from the ditch by walking through the dead stubble of *Typha latifolia* and *Carex rostrata* on which they rest. Freezing temperatures do not seem to injure the adults. As specimens have been found frozen on *Typha* stems and on being warmed in the hand, begin moving their legs.

The species has an extensive geographic range in Manitoba. Specimens have been collected in southern, central and northern Manitoba. Assuming continuous distribution, the species ranges between Winnipeg in the south and Gillam, near the Nelson River in the north of the province.

The following Manitoba material is in the writer's collection:

SOUTHERN MANITOBA:

WINNIPEG: 1 ♂, April 12, 1954; coll. W. V. Krivda.

This, the only specimen, was taken in flight over the lawn at United College in down town Winnipeg. The specimen possibly came from the Assiniboine River.

NORTHERN MANITOBA:

GILLAM: 1 ♂, April 3, 1955; 1 ♂, April 7, 1955; and 1 ♀, April 29, 1955; coll. W. V. Krivda.

These three specimens were taken over wide, shallow ditches overgrown with sedges, grasses and short willows. At this early date at the latitude of Gillam, the snow was still lying about in the shade of spruce and jack pine trees but for the most part was gone in open places. Many specimens were seen from time to time in early April and into May. At Gillam the species flew in bright sunlight ten feet off the ground. By estimation, it may be said that about ten specimens could be easily counted in a mile's walk along the railway track bordered by shallow ditches and bogs.

CENTRAL MANITOBA:

THE PAS: 2 ♂, April 3, 1959; 4 ♂, 3 ♀, April 6, 1951; 1 ♂, April 16, 1951; 2 ♂, April 27, 1951; 11 ♂, 11 ♀, April 3, 1953; coll. W. V. Krivda. 1 ♂, April 15, 1954; coll. Sam Waller.

The species is frequent at The Pas. The Indian Reservation, just across the bridge and near the Indian Anglican Church, is a good locale. Here also the species occurs along the edge of a sphagnum bog running parallel to the road. Black spruce, tamarack, *Salix bebbi, Typha latifolia, Carez rostrata* etc., formed the basic plant association.

The moth, *Acleris hudsoniana,* flies together with the fish fly. Later in the season the butterfly, *Oeneis jutta ridingiana,* occurs in this swamp.

At The Pas, *C. areolatum* flies over snowdrifts in late March and early April. It occurs in the town even along inhabited streets and over cultivated gardens. The indication seems to be that it emerges in the fall, hibernates as the adult and begins to

appear on the wing in the first few warm days of spring. A possible explanation for the infrequency with which this species is encountered in collections is that it is missed by most field collectors, going into the field, as they do, towards the end of May or beginning of June. With earlier collecting the species will possibly be found to have a wide geographic coverage.

I wish to express my thanks to Dr. Fernand Schmid of the Zoological Museum, Lausanne, Switzerland, who kindly identified material.

NEST STRUCTURE AND REPRODUCTION IN THE MOUND-BUILDING ANT *FORMICA OPACIVENTRIS* EMERY IN WYOMING[1]

BY GERALD SCHERBA
CHICO STATE COLLEGE, CHICO, CALIFORNIA

This report records observations on mound structure, reproduction and relationships among nests of *Formica opaciventris* Emery a hitherto little-known Western species of ant. This information has relevance as a contribution to our understanding of the ecology, behavior and social structure of the *exsecta* group of the subgenus *Formica* to which *Formica opaciventris* is assigned.

Extensive observations were carried out during June, July and August of 1957 and 1959, with brief two-week visits to the mounds in 1956 and 1958. The study area is located on Moose Island, a small island, one-half by one-quarter mile in size, located in an ox-bow of the Snake River, two miles east of Jackson Lake in Teton County, Grand Teton National Park, Wyoming. The island is at an elevation of 6775 feet and is placed in the Transition Life Zone by Cary (1917).

The central portion of Moose Island, where the mounds of *F. opaciventris* are situated, consists of a silver sagebrush, *Artemisia cana,* meadow in which *Festuca idahoensis* and *Taraxacum officinale* are dominant in the understorey. The soil is a rich, black, organic loam. The meadow is bordered on four sides by the shoreline, a lodgepole pine stand, a quaking aspen stand and

[1] Project 80 of the Jackson Hole Biological Research Station, Moran, Wyoming. This research was supported by funds supplied through the generosity of the New York Zoological Society and the American Academy of Arts and Sciences.

It is a pleasure to acknowledge the important help of Dr. L. Floyd Clarke, Director of the Research Station, who first discovered the mounds of Moose Island and whose continued interest and encouragement facilitated this study. Dr. Robert E. Gregg, University of Colorado, has kindly determined the species described in this report as *Formica opaciventris* Emery. Coral Scherba assisted in all phases of the field work and in the preparation of the manuscript.

The author wishes to express his gratitude to the National Park Service for permission to conduct this investigation within the boundaries of Grand Teton National Park.

a low wet sedge meadow. Portions of the central and southern parts of the silver sagebrush meadow contain swales in which a sedge, *Carex* sp. is the dominant plant. The swales were covered with standing water during June and early July of 1956 and 1957. Approximately 400 mound nests of *Formica opaciventris* are distributed throughout most of the meadow with but few mounds along the pine forest and aspen ecotones and none in the swales.

The *exsecta* group of *Formica* in North America comprises three species; *exsectoides, ulkei* and *opaciventris,* and they range from the Atlantic coast through the Rocky Mountain region. There is some overlap in range between *exsectoides* and *ulkei* in Illinois and Indiana, and *exsectoides* and *opaciventris* in Colorado and New Mexico (Gregg, 1952; Cole, 1954). The distribution of *opaciventris* is poorly defined but probably includes western Montana as well as Wyoming, Colorado and New Mexico.

Formica opaciventris was described by Emery as a variety of *exsectoides,* based on his examination of workers only. Wheeler (1913) changed this status to that of a subspecies of *exsectoides* and added the description of a single male specimen. Creighton (1950) elevated *opaciventris* to specific status on the grounds that the workers are as distinct from *exectoides* as are the workers of *ulkei.* Gregg (1952) described the female of *opaciventris* and noted that the differences between the females of *opaciventris* and *exsectoides* were not great.

Both *exsectoides* and *ulkei* are rich in striking patterns of behavior and have been studied repeatedly. Both species build large earthen mounds which they cover with thatch, these nests occurring as large aggregations of mounds. McCook (1877) estimated that a population near Hollidaysburg, Penna., included 1700 *exsectoides* mounds, and in Illinois Dreyer and Park (1932) counted more than 450 *ulkei* mounds. Both species are polygynous and exhibit secondary pleometrosis in which mated females return to established nests (Wheeler, 1906; Cory and Haviland, 1938; Scherba, 1958). New mounds are formed by budding from established nests and by temporary social parasitism of *Formica fusca* Creighton, 1934, 1950). In the European species *Formica exsecta,* single colonies are reported to occupy more than 100 nests interconnected by runways, so-called polydomous or polycalic colonies (Forel, 1928). While this has not been reported

for the North American species, *Formica exsectoides* workers ''visit'' between nearby mounds (Wheeler, 1928).

It is of considerable interest to determine which of these traits is present in *F. opaciventris,* and the extent to which differences exist among the species in this group of closely related ants.

NEST STRUCTURE

The nests of *Formica opaciventris* at Moose Island are low, conical earthen mounds, varying in size up to a basal diameter of 78 inches and a maximum height of 24 inches at the mound apex. These mounds are asymmetrical and have a long, broad slope oriented toward the east, southeast, or rarely, south. A census of the slope direction of 95 active mounds with a clearly discernible long slope indicated 52 mounds sloping to the east; 42 sloping to the southeast, and one mound partially shaded on the east, sloping to the south. Presumably the long slope face indicates that direction in which optimal conditions for nest construction are present for the longest periods of time.

The mound crust of consolidated, compact soil is overlain by a thin layer of freshly mined soil particles. Scattered lightly and irregularly over this is a covering of thatch, consisting of plant debris; leaf petioles, dead grass stems, pine needles, occasional green tips of rush, seed coats and the like. The lower slopes and basal areas of the mounds are fringed by a growth of rush, *Juncus* sp. probably *Juncus balticus,* whose underground stems, roots and rhizomes are thickly entangled, buttressing the mound structure. While the apex and upper slopes of the most populous and active mounds are bare of vegetation, *Juncus* is thinly scattered over the upper surfaces of the less vigorous mounds, growing highest on the west facing slopes. Extending horizontally outward from the basal surface of active mounds for up to 15 inches is an apron of mined soil with numerous nest entrances. Scattered nest entrances also occur from the base to the apex on all slopes.

On August 12, 1959, nest **459,** a medium sized active mound was excavated to a depth of five feet below the level of the soil surface. The following description of the mound structure is based on this nest.

The mound interior consists of soil together with a small amount of undecomposed vegetative debris. Horizontal circular

and vertical galleries varying in diameter up to one-half inch honeycomb the mound portion of the nest except at the basal margin, the area of dense *Juncus* roots. Galleries within the mound itself are numerous but their density decreases in the soil beneath the mound. There is a striking coincidence between the decrease in gallery density and the soil profile. In the mound and upper loamy soil layer, galleries are numerous down to a depth of approximately 8 inches beneath the soil surface. In the B horizon the soil becomes blocky and enriched with clay. Here the galleries are less dense although abundant down to a depth of two feet below the soil surface. In the C horizon, beginning at about two feet below the soil surface, the soil is hard, contains silt and very fine sand and is structured as large angular blocks. A few scattered galleries are present here and some of these extend vertically to a depth greater than five feet below the soil surface.

In the mound examined, and possibly unique to that mound, was a large oval chamber, six inches in length, 4 inches in height and approximately four inches deep. This chamber was situated eight inches below the mound apex at the level of the adjacent soil surface. The chamber was filled with undecomposed thatch and fine bits of organic debris of a size that could have been carried into the nest by the workers. The function of this cavity was not apparent, and a corresponding cavity could not be found in two similar mounds which were examined. Our present interpretation is that the chamber originated as a damaged or trampled portion of the mound which was filled with thatch and covered over with soil particles.

THATCHING BEHAVIOR In an attempt to determine some of the factors effecting nest-building behavior, field experiments were conducted on the effect of moisture on the rate of thatching. Moisture was chosen because of repeated observations recorded in the literature, that nest building activity increases following rainfall (e.g. Wesmann, 1905). Recent experiments on other aspects of nest building have been conducted by Chauvin (1958, 1959a, 1959b).

In each of three experiments two areas each of 16 square inches of nest surface were delineated and the number of pieces of thatch carried into these areas by the workers was counted and removed each day. The experimental area and the entire

mound slope containing it was sprinkled with 5 litres of water from a sprinkling can each day. The control area and the slope containing it was not watered.

In Experiment 1, the rate of thatching by workers of nest **317**, watered, was contrasted with that of adjacent, similar, nest **316**, unwatered. After three days the watering schedule was reversed and nest **316** was watered.

In Experiment 2, the east facing slope of nest **323**, watered, was contrasted with the unwatered west facing slope. After 4 days the watering schedule was reversed.

In Experiment 3, the northeast slope of nest **198**, watered, was contrasted with the unwatered southeast slope.

Results are arranged as Table I. The data indicate that the effect of watering is to increase the rate of thatching, hence watered slopes are thatched to a greater extent than unwatered slopes. Reversal of the watering schedule resulted in a reversal of the relative thatching rates, indicating that the observed results are due to effects of watering and not to other differences existing between the experimental and control areas. The data have been further examined using a t-test for paired comparisons and the amount of thatch carried onto watered slopes is significantly greater than that carried onto unwatered slopes ($t = 11.2$; $p < .01$). There is considerable day-to-day variation in thatching rate on both watered and unwatered slopes. This may reflect the effect of other environmental factors, such as temperature, on thatching rate.

REPRODUCTION

Formica opaciventris resembles the other North American *exsecta* species in maintaining polygynous colonies. A small nest, **290**, excavated on June 26, 27, 1957, contained 101 active dealate females.

Males occur in two distinct size classes. Total length measurements of 23 males from several mounds indicates a *micraner*, 6.5–8 mm. and a *macraner*, 9.0–10.1 mm. using the terminology of Wheeler (1910). The *micraner* appear smaller and more slender but otherwise are similar to the *macraner*. Both sizes have been observed in the same colony, although some mounds contain only one class. Both sizes have been observed to copulate with *opaciventris* females, and no functional differences are apparent.

TABLE I

NUMBER OF THATCH PARTICLES BROUGHT BY WORKERS ONTO WATERED AND UNWATERED NEST SLOPES

Experiment 1

Numbers bearing asterisk are tallies made on watered nests

Date	Nest 316	Nest 317
August 6, 1959	97	88
7	55	87*
8	62	127*
10	85	134*
11	210*	130
12	243*	122
13	247*	177
14	227*	106
15	243*	100
16	276*	75

Experiment 2—Nest 323

Numbers bearing asterisk are tallies made on watered slopes

Date	East Slope	West Slope
August 6, 1959	40	62
7	81*	27
8	121*	32
10	86*	35
11	100*	78
12	14	72*
13	177	213*
14	22	123*
15	75	149*
16	49	160*

Experiment 3—Nest 198

Numbers bearing asterisk are tallies made on watered slope

Date	Southeast Slope	Northeast Slope
August 12, 1959	14	72*
13	177	213*
14	22	123*
15	75	149*
16	49	160*

SEASONAL LIFE CYCLE Eggs are present in the mounds in June and they complete development to adult worker or sexual in August, a pattern similar to that observed in *F. ulkei.* Mating flights occur in August with new nests formed by budding. Nest **153**, believed to be formed by budding during June or July, 1957, was excavated on July 25 of that year. The population consisted of approximately 30 workers without brood or sexuals.

PRODUCTION OF SEXUALS In the course of observations on mating behavior in 1957 it appeared that not all mounds were releasing sexuals and that among the mounds in which sexuals were produced, some released only males, some only females, others both males and females. Systematic observations were then attempted to determine the percentage of mounds liberating sexuals, here called fertile mounds, and to determine the proportion of male releasing to female releasing mounds.

TABLE II

NUMBER OF WINGED SEXUALS OBSERVED ON MOUND SURFACE BEFORE MATING FLIGHTS, 1957

Date	Nests Inspected	Males		Females
Aug. 12	25	1		3
14	45	135		8
15	108	1355		65
16	88	3		6
TOTAL	152	1494		82
RATIO		18.2	:	1

In 1957, 152 mounds were censused between August 12 and 16 during the early morning interval between the time that the sexuals emerge from within the nest to parade over the mound surface, and flights begin. The number and caste of winged adults was estimated for as many mounds as could be visited each day. As a result of the information gathered in 1957 the census was repeated between August 15 and September 1, 1959, omitting the estimate of the number of sexuals per nest in order to examine a greater number of mounds. It should be clear that the number of sexuals recorded as observed on the mound surface in 1957 (Table II) represents a best estimate of the actual number present. A precise count is not easily obtained under such circum-

stances. Further, mounds are tallied as fertile or sterile on the basis of the presence of winged sexuals on the mound surface at the time of census without excavation of the mounds at any time.

TABLE III

PROPORTION OF MOUNDS ON WHICH SEXUALS WERE OBSERVED EACH DAY DURING MATING PERIOD. AUGUST 1957 AND 1959

Date	Mounds Inspected	Only ♂	%	Only ♀	%	Both ♂ and ♀	%
Aug. 12, 1957	25	1	4.0	2	8.0	0	0
14	45	11	24.4	0	0	2	4.4
15	108	25	23.1	0	0	7	6.5
16	45	3	6.7	1	2.2	0	0
Aug. 15, 1959	137	22	16.1	2	1.5	1	0.7
16	144	20	13.9	1	0.7	2	1.4
17	210	39	18.6	2	0.9	1	0.5
18	239	25	10.5	3	1.3	2	0.8
23	145	17	11.7	3	2.1	3	2.1
24	252	24	9.5	2	0.8	4	1.6
28	218	10	4.6	3	1.4	2	0.9
Sept. 1	205	0	0	1	0.5	0	0

Date	Total ♂	%	Total ♀	%	Total Mounds With Sexuals	%
Aug. 12, 1957	1	4.0	2	8.0	3	12.0
14	13	28.9	2	4.4	13	28.9
15	32	29.6	7	6.5	32	29.6
16	3	6.7	1	2.2	4	8.9
Aug. 15, 1959	23	16.8	3	2.2	25	18.3
16	22	15.3	3	2.1	23	16.0
17	40	19.0	3	1.4	42	20.0
18	27	11.3	5	2.1	30	12.6
23	20	13.8	6	4.1	23	15.9
24	28	11.1	6	2.4	30	11.9
28	12	5.5	5	2.3	15	6.9
Sept. 1	0	0	1	0.5	1	0.5

The release of sexuals extended over a period of several days both in 1957 and 1959. During the period of mating flights in 1957 the number of sexuals observed on the mound surface increased abruptly to a maximum on August 15 and then declined sharply. Males and females were observed in a ratio of approximately 18 : 1 (Table II). The number of sexuals observed on the

mound surface varied widely from mound to mound. Some nests released as many as 300 males while the number of females observed at a single mound did not exceed 41.

Not all of the mounds examined in 1957 and 1959 were fertile. Instead, a reproductive division of labor existed with fertile nests comprising between 20% and 25% of the population. The proportion of fertile nests observed on any individual day varied from 7% to 30% of the nests sampled that day, with a decrease in the proportion of fertile mounds occurring abruptly in 1957 and gradually in 1959, at the end of the flight season (Table III).

Nests liberating males were more numerous than those liberating females with a male : female ratio of 5.5 : 1 in 1957, and 7.6 : 1 in 1959. Most of the nests which produced females also produced males, with a ratio of male only : female only mounds of 30 : 1. Nests releasing both males and females comprised between 2% and 5% of the populations of mounds, while mounds releasing females only comprised less than 1% (Table IV). No consistent differences have been found as to appearance of the mound or the activity of the inhabitants between male producing, female producing and sterile mounds.

TABLE IV

OVERALL PROPORTION OF MOUNDS ON WHICH SEXUALS WERE OBSERVED AUGUST 12–16, 1957 AND AUGUST 15–SEPTEMBER 1, 1959

	1957		1959	
	Number	%	Number	%
Mounds Censused	152		326	
Sterile	115	75.7	256	78.5
Fertile	37	24.3	70	21.5
♂ Only	29	19.1	61	18.7
♀ Only	1	0.7	2	0.6
♂ and ♀	7	4.6	7	2.1
Ratio of male : female releasing mounds	5.5 : 1		7.6 : 1	

Of the 326 nests censused in 1959, 147 were also examined in 1957. What changes in reproductive status occurred to this population of mounds? Most of the population, 76.9%, had not changed. However, 12.2%, fertile in 1957, had become sterile by 1959 and 8.8%, sterile in 1957, had become fertile. Of the

37 mounds which were fertile in 1957, only 16, 43.2%, were still fertile in 1959. Almost 50% of these fertile nests had become sterile. Of the 8 mounds containing females in 1957, none contained females in 1959. Three mounds changed sexual status between 1957 and 1959; two from male and female producing to male only and one from male only to female and male producing (Table V).

If we assume that the proportion of mounds which become sterile or fertile each year is approximately equal and constant from year to year, then we may tentatively infer that mounds are fertile for approximately four years with 25% of the fertile population becoming sterile each year.

TABLE V

Reproductive Status of Mounds Censused Both in 1957 and 1959

	Number	%
Nests censused	147	
Fertility status unchanged	113	76.9
Fertility changed	34	23.1
became sterile	18	12.2
became fertile	13	8.8
changed sex	3	2.0
Mounds fertile in 1957	37	
still fertile in 1959	16	43.2
sterile in 1959	18	48.6
fertile but changed sex	3	8.1

Flight activities Observations on mating behavior in *Formica opaciventris* were conducted on August 10, 12, 15, 16, 1957, and on August 15, 17, 18, 23, 24 ,1959, at the study area. Flight activities occur in the morning, between 7 A.M. and 10 A.M. and follow the sequence; emergence of the males, emergence of the females, flight of the males, flight of the females, mating, and return of the females to the mound.

The males emerge from the nest after the workers are already on the mound slopes, between 6 : 55 A.M. and 7 : 25 A.M., and they crawl aimlessly over the mound surface and cluster at nest entrances. The females emerge and also crawl over the mound surface, slowly at first, later more rapidly. Males and females parading over the mound surface occasionally meet but there is

no avoidance nor attraction apparent at this time. When workers encounter sexuals they attempt to seize them by a leg or antennae. Sexuals so caught struggle and escape.

As air temperature rises the males leave the mound surface and climb the stems of herbaceous plants growing from the mound or at the mound periphery. They climb to the tips, turn around and around, flutter their wings and continue in this manner for several minutes. The male flight begins with a final flutter, and the males depart, singly, flying low, just above the tops of the herbaceous plants.

The females parading over the mound surface now travel down the slope and into the vegetation adjacent to the mound margin, or onto stems of plants emerging from the mound. They climb to the top of the plant stem, flutter their wings and fly—usually less than ten feet, and frequently simply to a nearby plant stem three or four feet away. Some females crawl down from the plant tip and onto a second, usually higher plant, before flying. Others climb down and reënter the nest without flying. At the end of the flight season in 1959 a few females were observed to fly longer distances; 30 feet, 100 feet, 150 feet and a few flew up and away out of sight, flying strongly in the direction of increased light. These latter females originated from a nest at the eastern edge of the population of mounds, and their flight took place at a time when no males were seen.

As the males fly into the vicinity of a female-releasing nest, the females remain scattered at heights up to three feet in the vegetation at the mound periphery. The observer at the mound receives the impression that the males are not flying at random but are oriented in the direction of the few mounds at which females are released. Males fly directly to within four to six inches of a female, alight, then search about randomly in an agitated manner. When a male encounters a female, copulation occurs after brief "chasing." Copulation lasts from 40 seconds to 2 minutes and is termniated by the female who bites the abdomen of the male and pinches it with her legs, forcibly separating herself. Some females have been observed to mate twice, with a different male at each occasion.

After copulation the males fly away or flutter weakly to the surface of the ground. Foraging workers seize these males and carry them into nest openings, presumably as food. After groom-

ing, the post-copulatory females climb down the plant stem, crawl along the ground surface and re-enter the mound through an opening at the basal edge. Of three females marked with nail polish after copulation, two were lost from sight, and one was carried within the mound, intact, by workers, a pattern referred to as "escorting" in the literature. However, at another mound two post-copulatory females individually met workers near the mound and these workers made no attempt to seize or restrain them. The females re-entered the mound unescorted.

On mornings after the flight season has ended, alate females parade on the mound surface, but re-enter the mound without flying.

Recently Kannowski (1959) and Talbot (1959) have demonstrated that flight activities are regulated by climatic events in several ant species, and this appears likely in *F. opaciventris* also. The morning of August 19, 1959, was cool, wet and foggy and no alates flew although flights occurred before and after that date. Male flight was interrupted on August 15, 1957, as the sky was overcast. When the sky cleared and temperatures rose, flights resumed. Air temperature measurements at a height of 12 inches indicate that when males first appear on the nest surface air temperatures are between 6.5° C. and 14.5° C.; when females first appear air temperatures are between 10.0° C. and 16.9° C. Both males and females have been observed to fly at a time that air temperatures were between 12.2° C. and 21.2° C. When mating occurs temperatures are between 13.0° C. and 21.2° C.

RELATIONSHIPS AMONG NESTS[2]

In August, 1959, marking experiments were conducted in order to determine whether workers at one mound also frequented other mounds. In each of four trials several hundred workers were individually taken from the surface of a mound, marked with one of 3 colors of nail polish, and replaced. Nearby mounds were later inspected for the presence of marked ants. Marking in this fashion did not appear to alter the behavior of the workers, who were later observed transporting pupae and nest building. A single marking persists for several days.

[2] The observations described in this section were begun in response to a suggestion of Dr. Mary Talbot, Lindenwood College, that several mound nests of *F. ulkei* may be interrelated by virtue of workers moving back and forth between mounds.

TRIAL 1 Two mounds, **468** and **470**, located contiguously with their basal edges connected by mined soil tunneled with entrances. Workers marked at **468** were found on **470**; one worker marked at **470** was found on **468**.

TRIAL 2 Three mounds, **74**, **75** and **76** arranged in a triangular manner with 9, 10 and 12 inches between the basal edges. Workers marked at **74** were found at **75** and **76**. Workers marked at **75** were found at **74** and **76**. Workers at **76** were not marked. Workers marked at both **74** and **75** were observed to carry soil as in nest building at **76**.

TRIAL 3. Two mounds, **281** and **954**, located 8 feet, 8 inches apart. **954** is believed to be a bud of **281**, founded in 1957. Workers marked at **954** were observed at **281** and workers marked at **281** were observed on **954**.

TRIAL 4 Three mounds, **206**, **321** and **294**, situated such that **206** is 3 feet, 2 inches from **321** and 15 feet from **294**. **294** is 13 feet, 5 inches from **321**, arranged in this order:

206
321 **294**

Workers marked at each of these nests were found on the surfaces of the other two mounds. Marked workers from each of these nests were also found on other nearby mounds. Two of these mounds were at a distance of 25 feet from **294** and one mound, **198**, with a single worker each from **206** and **294** was 55 feet from **206**. In several instances workers marked at one nest were carrying soil or empty pupal cases at another nest.

We may conclude that workers move from one mound to another up to a distance of 55 feet. The meaning and extent of these movements are unknown.

DISCUSSION

The life history of an individual mound probably follows this cycle: Mounds are formed by budding from parental nests and, in time, increase in size and in number of inhabitants. After an unknown period the condition of the population of the mound becomes such that sexuals are produced, and this reproductive period is estimated to last four years. After a further length of time the population declines, the mound becomes overgrown with vegetation and either dies or becomes rejuvenated by a reinvasion from a budding population.

Although workers evidently move back and forth between mounds, we would still consider all except incipient mounds to be separate colonies, a view already expressed by Wheeler (1928). Forel's concept of a polycalic colony, in which one colony occupies several mounds, does not appear useful in this situation. However, it is entirely possible that these colonies share a common worker pool, to the extent that, in time of need at one colony, the potential worker force available would be considerably greater than the population of workers at that mound. The adaptive value of such a system would be enormous.

The reproductive division of labor, such that only 25% of the mounds are fertile during a single season appears to be an adaptive mechanism which increases the efficiency of the population of mounds as a whole. However such a system with its exceedingly low rate of production of females can only be of selective advantage if fertilized females are afforded a maximum of protection from predators and other circumstances which might limit their survival. The abbreviated flight of the females, with return to the nest and the formation of new mounds by budding provides this maximum protection, while permitting mating of sexuals from different mounds.

Under such a reproductive pattern the unit of natural selection becomes not the individual alate, nor the individual colony, but the population of colonies. The interrelationships between mounds and the division of reproductive labor within the population are essentially integrating mechanisms which operate here at the level of the population of societies.

Is it possible to begin a tentative comparison of certain behavior traits found within the *exsecta* group in North America?

Differences in mound structure exist. While mounds of *exsectoides* and *ulkei* could not be distinguished from one another in Illinois, mounds of *opaciventris* in Wyoming have a thinner crustal layer, incorporate less vegetation, and are covered with a sparser layer of thatch. The mound slopes of *exsectoides* and *ulkei* are free of vegetation, unlike those of *opaciventris*. These differences could, of course, be due entirely to differences in environment.

The reproductive pattern appears quite similar among the three species and is consistent with the general pattern in many ant species detailed in the recent fine study of Kannowski (1959).

New mounds are formed by budding in all three species, although details of this pattern are obscure and could reveal differences. Both *exsectoides* and *ulkei* form occasional mixed colonies with other species, especially *Formica fusca,* presumably by temporary social parasitism. Mixed colonies of *opaciventris* have not yet been found, although numerous *Formica fusca* colonies encircle the *opaciventris* mounds at the study area.

TABLE VI

COMPARISON OF REPRODUCTIVE BEHAVIOR PATTERNS AMONG SPECIES IN THE *exsecta* GROUP OF *Formica*

Trait	*exsectoides*	*ulkei*	*opaciventris*
Mating flights begin	"at the close of June" (McCook, 1877)	June 26	August 15
Flight time		Early morning	Early morning
Males first appear on nests		Approx. 11.0°C.	6.5°C.–14.5°C.
Temperature at which flights occur		15°C.–22°C.	12.2°C.–21.2°C.
Mating flight of female		Strong, definite upward flight	Flight of a few feet
Behavior of mated females	Return to established nests (Wheeler, 1906)	Return to established nests	Return to nest of origin
Formation of new nests	Temporary social parasitism and budding (Creighton, 1950)	Temporary social parasitism and budding (Creighton, 1934)	Budding

The flight dates are concurrent for *exsectoides* and *ulkei* and occur approximately six weeks earlier than that of *opaciventris.* The flights of both *ulkei* and *opaciventris,* occur in the early morning hours over a period of several days. Both the temperature at which males first appear on the nest and flight temperatures are lower in *opaciventris* than in *ulkei.* Whereas in *ulkei* the flight of the females is strong, definite and upward, that of *opaciventris* is notably brief and limited, with the exception noted earlier. In all three species the mated females return to established nests, although there is no evidence that in *exsectoides* or *ulkei* females return to the mounds of their origin. In all three species workers ''escort'' mated females back into the nest, and

ulkei workers dealate the females on the mound surface before they enter the nest. These comparisons are summarized as Table VI, from data presented in Scherba (1958) and Talbot (1959).

SUMMARY

Field observations of a population of nests of the mound-building ant *Formica opaciventris* were conducted in 1957 and 1959 in western Wyoming.

The mound nests are galleried earthen structures covered by a layer of thatch. Thatching behavior is affected by environmental factors such that watering a portion of a mound, or an entire mound significantly increases the rate of thatching.

The mounds are polygynous, release males of two distinct sizes and form new mounds by budding. Brood development is initiated and completed within a single season.

There is a division of reproductive function among the population of mounds such that between 20% and 25% of the mounds are fertile (release alates) during each season, with a ratio of male releasing : female releasing mounds of between 5 : 1 and 8 : 1. Females are released from 3% to 5% of the mounds. It is estimated that mounds are fertile for approximately four seasons, with 25% of the fertile mounds becoming sterile each year.

Mating flights occur over a period of several days in August during the morning hours only. Mating occurs on the stems of herbaceous plants with mated females returning to the mound of their origin after a mating flight of only a few feet. This reproductive pattern differs somewhat from that of other members of the *exsecta* group, and these differences are tabulated.

Marking experiments indicate that workers at one mound can also be found at other mounds in the vicinity with a maximum observed visiting radius of 55 feet.

The reproductive division of labor and the interrelationship between workers of different mounds are interpreted as integrating mechanisms which operate at the level of the population of societies.

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THE EARLY STAGES OF BREPHIDIUM PSEUDOFEA (MORRISON) (LEPIDOPTERA, LYCAENIDAE)

By George W. Rawson
New Smyrna Beach, Florida

Since very little seems to be known about the early stages of the Eastern Pygmy Blue Butterfly, *Brephidium pseudofea* (Morrison), it is hoped that the following observations will be of interest. Klots (1951, p. 163) recorded having seen the species swarming in Florida in a semi-tidal flat at the edge of mangroves overgrown with saltwort (*Batis*) and glasswort (*Salicornia*). While the butterfly's normal range in the United States is from the Florida Keys north into Georgia, and probably in the Gulf States east of the Mississippi, it rarely wanders far from the coast. These facts gave the necessary clues to the writer for investigations which were carried on near New Smyrna Beach, Florida. As a result, glasswort (*Salicornia bigelovii* Torr.) was definitely found to be a larval foodplant; and there is reason to suspect that saltwort (*Batis maritima* L.) may also be a larval foodplant. Eggs and larvae were found on glasswort, May 20, 1959, and the insect was carried through to maturity on this plant. The larvae were found to chew the outer tissues of the stems and branches of this plant in a rather characteristic fashion. Very similar chewing was found on a few sprigs of saltwort collected at random in the same environment. Both of these halophilic plants grow in close association in salt marshes; and, at least in the New Smyrna area, saltwort is generally more abundant than glasswort, sometimes growing in pure stands acres in extent.

The butterfly is on the wing during the greater part of the year, i.e. from March to late November. However, it is difficult to determine the number of generations per year, if there is a definite number, because of the over-lapping of the generations in the semi-tropical climate. In peninsular Florida, the known range of the species is from New Smyrna (coastal salt marshes) south to Key Largo, Matecumbe Key and "presumably" other coastal islands.

THE OVUM

A considerable amount of time was spent hoping to witness

oviposition on the salt marsh vegetation, with no success. A careful search for eggs and larvae was then made with a hand lens on sprigs of glasswort. Finally, after numerous trials, both eggs and larvae were found. Since there was no definite assurance that this material represented the early stages of *pseudofea,* 4 eggs and 9 very small to medium sized larvae were collected and taken home for further study.

The eggs were very small; one specimen showed a diameter of about 440 μ. The egg is disc-shaped, being round and flat (a characteristic of Lycaenid eggs) and pearly white in color; the relatively small micropyle area is pale green. The upper surface is studded with numerous irregular, rounded depressions. Apparently the egg is laid singly on the basal portion of a branch close to the stem, a position that may be "instinctively" chosen as an aid to concealment. However, this is not an invariable rule, since a few eggs were found in more exposed positions on the branches. Since oviposition was not actually witnessed, the period for the hatching of the egg was not determined. However, 4 or 5 days might be suggested as a reasonable guess.

THE LARVA

After emergence the larva is approximately 1.5 mm. long. In color it is apple green, so closely resembling the color of the food plant as to suggest cryptic coloration. The same shade of green persists to the pre-pupational stage. Even while undisturbed, young larvae are capable of suspending themselves by a silk thread, which serves to prevent them from falling from the plant, or as a "life-line" if they do fall.

After emergence from the egg, the larva eats very little of the eggshell. As larval development proceeds the more or less uniform-appearing, apple green skin takes on a granular appearance. This is due to numerous small, hyaline papillae. These are basally broad, forming a pedicel that tapers toward the distal end, which terminates in a rounded knob. The papillae are moderately curved and slope cephalad at an angle of about 45. The granular appearance of the larval skin is presumably further evidence of cryptic, protective coloration, because it is closely similar to the minute punctations on the stems and branches of the glasswort.

The head of the larva is black or very dark brown; and while

the larva is feeding is kept almost, if not entirely, hidden by the enlarged prothorax which forms a hood over it. Both the anterior extremity of the hood, and the terminal edge of the anal segment, are fringed with rather short, fine hairs that possibly function as

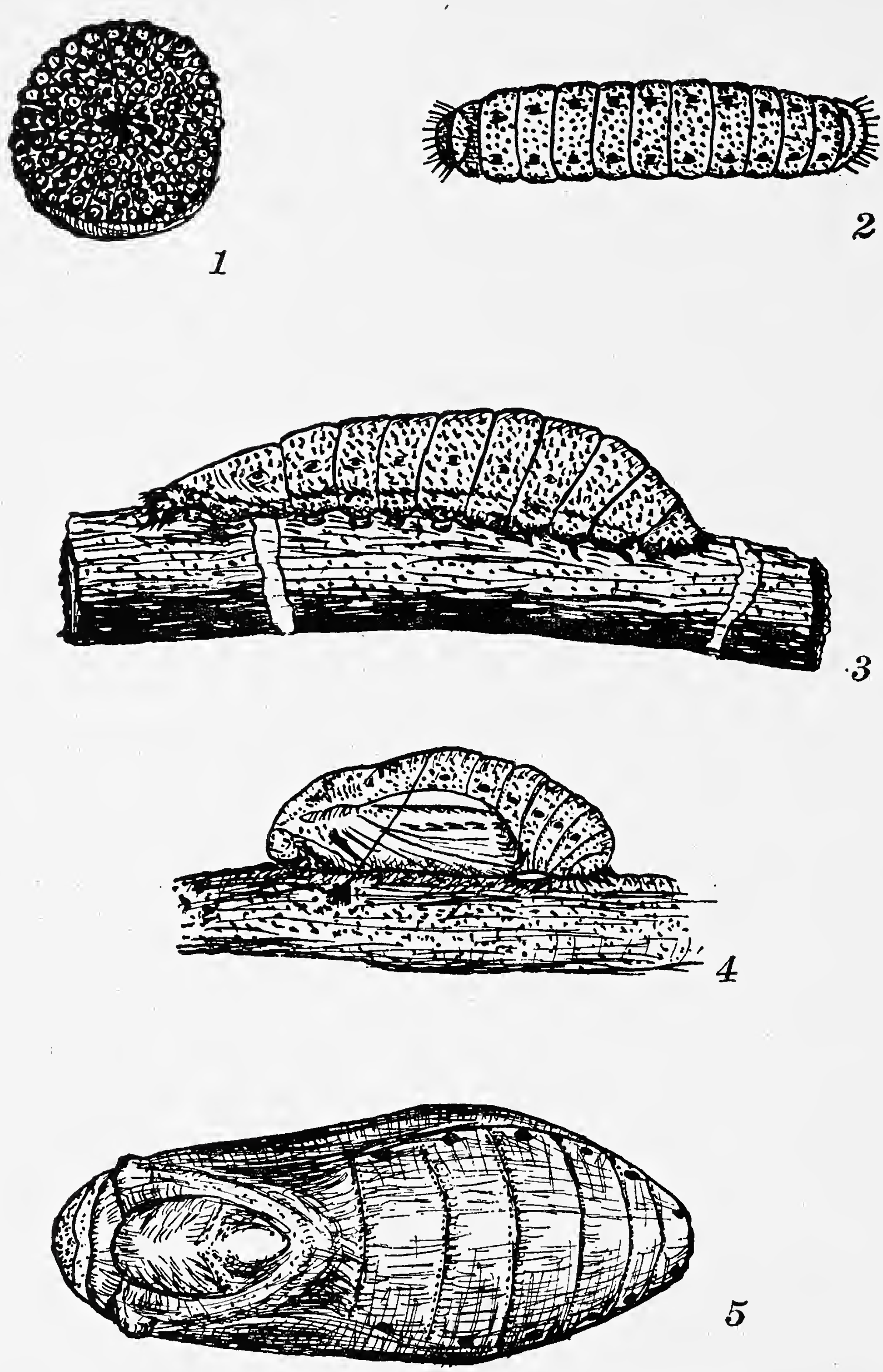

FIG. 1. *Brephidium pseudofea.* 1. Ovum, 440 μ. 2. Larva, dorsal view, 8 mm. 3. Larva, lateral view, 9 mm. 4. Pupa, lateral view, 6.5 mm. 5. Pupa, dorsal view, 6.5 mm × 10 mm.

tactile structures. Unfortunately, circumstances did not permit a careful study of the details of larval growth, or a record of the number of instars.

As previously mentioned, the larvae have a characteristic method of feeding. During early larval life the tips of the glass-wort branches are hollowed out deeply enough to conceal the larva. Later, the outer, succulent tissues of the plant are consumed so as to make rather deep, and relatively wide grooves, the length and width of which depend on the size of the larva.

THE PUPA

Just before pupation the larva becomes less elongated, and the thoracic region thickens, or ''hunches up'' as is characteristic of most lepidopterous larvae at this time. During pupation the color changes to a slightly lighter, more hyaline shade of green. The pupa resumes the normal green color, which so matches the pigmentation of the glassworth branch as to represent a very fine example of protective coloration. The pupa is attached to a branch by means of several strands of very fine silk which are fastened to the branch on each side of the pupa and pass dorsally over its thorax. The anal end of the pupa is also attached to the branch by numerous, rather loosely woven, strands of silk. The pupal stage of a small number studied lasted 4 to 5 days.

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THE COMPARATIVE ANATOMY OF DIGESTIVE GLANDS IN THE FEMALE CASTES AND THE MALE OF *CAMPONOTUS PENNSYLVANICUS* DEGEER (FORMICIDAE, HYMENOPTERA).

JAMES FORBES and AUGUST MARTIN MCFARLANE, F.S.C.[1]
BIOLOGICAL LABORATORY, FORDHAM UNIVERSITY, NEW YORK 58, N.Y.

Three pairs of well developed glands are usually associated with the digestive system in ants: the maxillary glands, the post-pharyngeal glands, and the salivary or labial glands. These glands have been described for some of the forms of several formicine and myrmicine ants by Meinert (1861), Lubbock (1877), Nassonow (1889), Janet (1894, 1897, 1898, 1904, 1905 and 1907), Bugnion (1930), and Forbes (1938). More recently descriptions of these glands have been made for two social parasitic ants, *Teleutomyrmex schneiderei* (Gösswald, 1953) and *Anergates atratulus* and its host, *Tetramorium caespitum,* (Meyer, 1955). Whelden (1957 a and b) has described the glands in two ponerine species.

The digestive glands in the queen and the male of the black carpenter ant, *Camponotus pennsylvanicus* DeGeer, have not been previously reported, nor have the size of the glands been compared in the different-sized workers. This paper is a comparative study of the anatomy of the digestive glands in the female castes and the male of this polymorphic species. In addition, comparisons have been made of all observations on these glands so far reported; since the queens, the workers, and the males have different functions within the colony, these comparisons may help toward an understanding of the functions of the glands.

MATERIAL AND METHODS

The specimens used in this study were collected in Westchester County, New York during July of 1936 and in Nassau County, New York during February 1953 and March 1954. The specimens taken in 1936 were fixed in alcoholic Bouin's fluid, those taken in 1953 in Kahle's fluid, and those taken in 1954 in 10 per-

[1] Present address: St. Joseph's Boys High School, West New York, N.J.

cent formalin. The material in Bouin's fixative was stored in 80 percent alcohol and the materials fixed in Kahle's fixative and in formalin were stored in 70 percent alcohol. All the queens used in this study were virgin, unmated queens.

The dissections were performed in Syracuse watch glasses, which had a thin layer of paraffin on the bottom. The specimens were placed in grooves on the paraffin surface and held in place by melting paraffin around them. They were then covered with 70 percent alcohol. The maxillary and the post-pharyngeal glands together with the anterior portion of the alimentary tract were removed as a unit. The salivary glands were separated from muscle and other surrounding tissues and they, too, were removed almost completely intact. These organs were stained with either Grenacher's borax-carmine or by Lynch's precipitated borax-carmine method (Galigher, 1934). In the organs stained with Grenacher's borax-carmine, it was observed that the stain was not retained in those structures which have a chitinous lining, but the other structures such as the maxillary gland cells were stained in a very satisfactory manner. For the purpose of studying the post-pharyngeal and salivary glands Lynch's precipitated borax-carmine method was found more suitable. The stained material was then dehydrated in ethyl alcohol and mounted in diaphane.

A Bausch and Lomb Tri-Simplex microprojector was used in preparing the drawings.

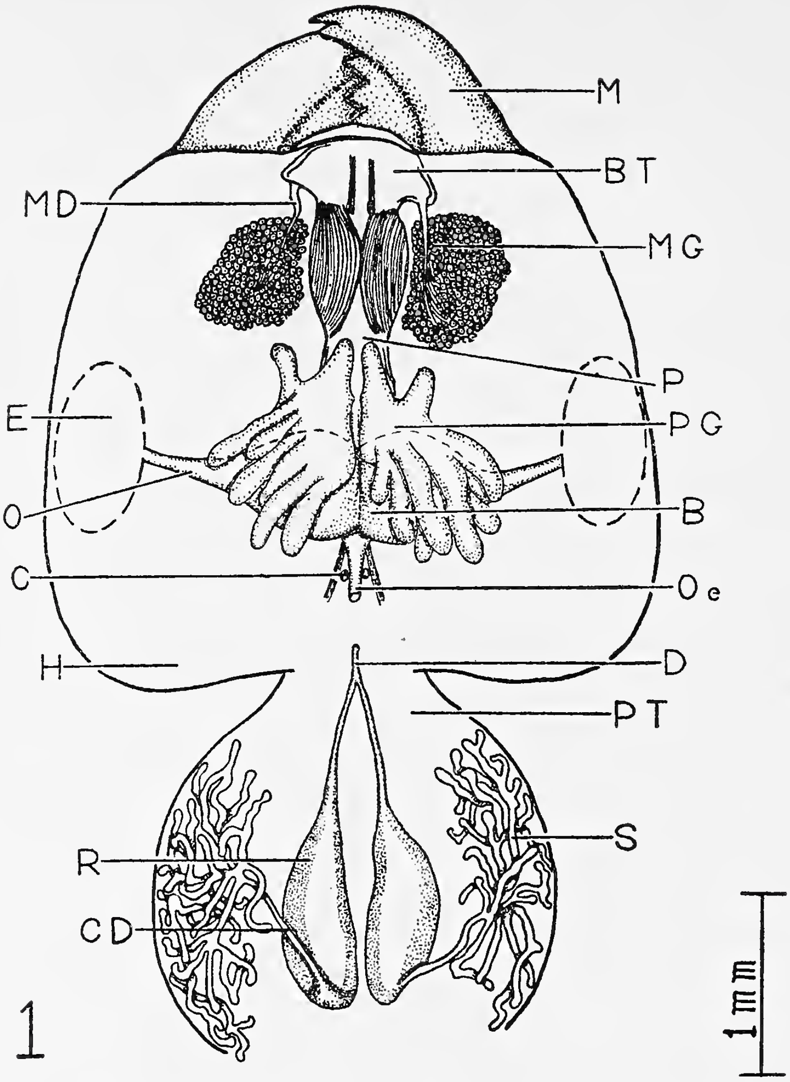
OBSERVATIONS

GENERAL DESCRIPTION OF THE GLANDS

The maxillary glands consist of two groups of cells which lie close to and on either side of the pharynx near the infrabuccal

EXPLANATION OF PLATES

FIGS. 1–5. DIAGRAMS OF DORSAL DISSECTIONS OF THE HEAD AND PROTHORAX OF THE VARIOUS *Camponotus pennsylvanicus* FORMS, ALL DRAWN TO THE SAME SCALE. 1. Large-sized worker, 2. Medium-sized worker, 3. Small-sized worker, 4. Male, 5. Queen. ABBREVIATIONS: A, apodeme; B, brain; BT, buccal tube; C, corpora allata; CD, collecting duct of salivary tubules; D, salivary gland duct; E. compound eye; FM, flight muscles; H, head capsule; L, labrum; M, mandible; MD, maxillary gland duct; MG, maxillary gland; O, optic nerve: Oe, oesophagus; P, pharynx; PG, post-pharyngeal glands; PT, prothorax; R, salivary gland reservoir; S, salivary gland tubules.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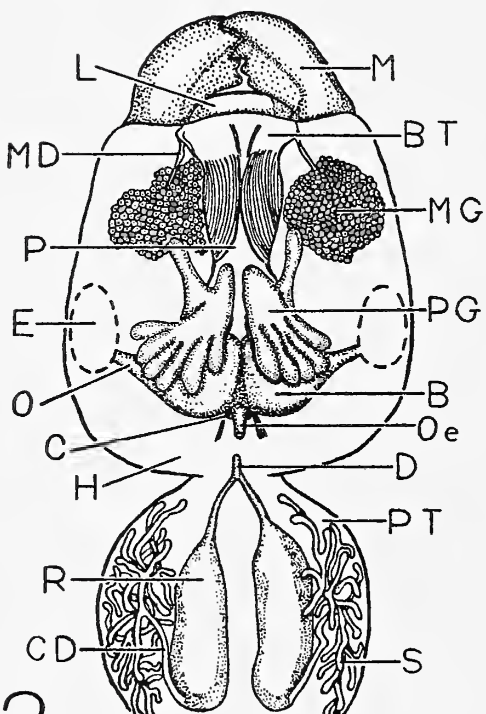
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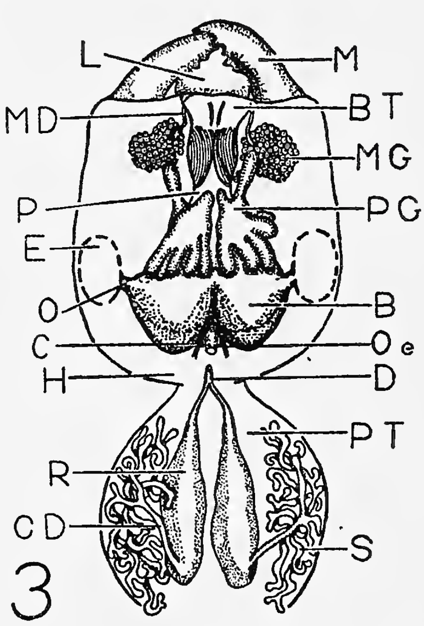
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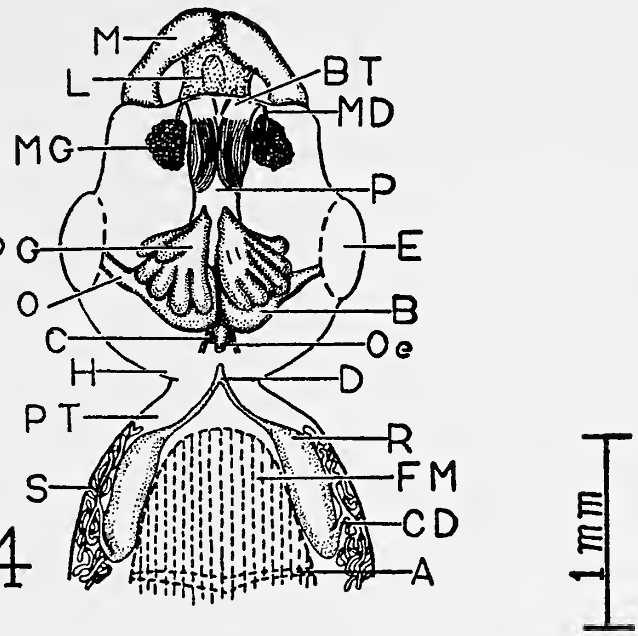
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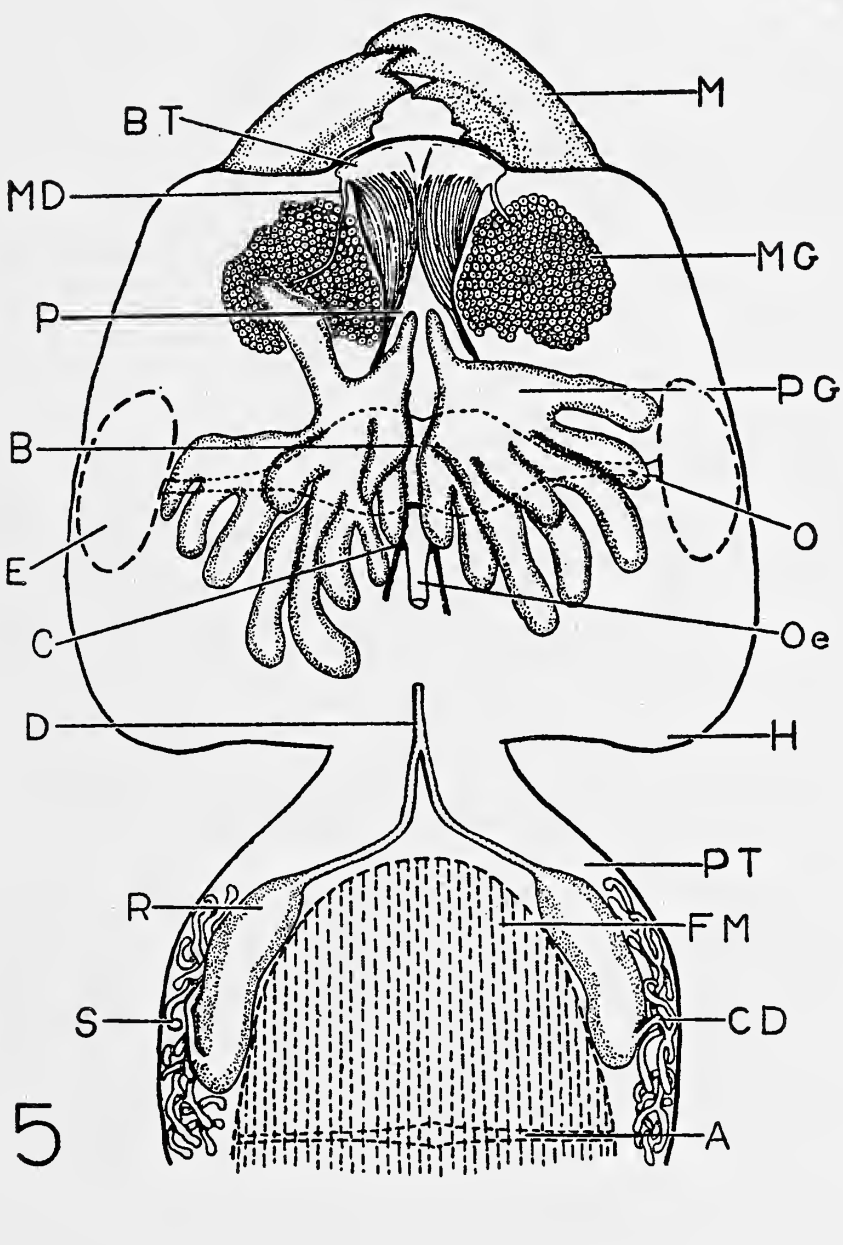
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chamber. They extend laterally into the head cavity (fig. 1). The large gland cells contain large, centrally located nuclei. When free from the pressure of surrounding cells, these gland cells are spherical or oval-shaped; however, because of the number of cells in the glands, the shape is usually determined by mutual compression of the surrounding cells. Each cell is drawn out on one side to form a single, slender duct. The cell ducts of each gland unite to form a main duct. These ducts continue forward and open on the posterior lateral margins of the buccal tube.

The post-pharyngeal glands are a pair of branched, tubular-shaped glands which arise from the dorsal, posterior region of the pharynx (fig. 1). These are the largest glands found in the head. Most of the finger-like tubes extend posteriorly and lie over the brain, some extend anteriorly and almost parallel to the pharynx, while others extend laterally. A few tubes usually extend downward around the anterior part of the brain. The tubes of each gland are arranged in a fan-like fashion with the tubes uniting at the base. Each gland then opens separately on the dorsal, posterior portion of the pharynx.

The salivary or labial glands are situated in the dorsolateral regions of the prothorax (fig. 1). They consist of two groups of thin-walled, multibranched tubules which extend forward to the anterior wall of the prothorax and posteriorly to the mesothorax. Some of the glandular tubules lie between the muscles of the prothorax. The branched tubules of each gland unite to form a single duct, which opens into the posterior end of a thin-walled, dilated reservoir. The reservoirs lie ventromedially to the glands. The narrow duct which leads from the anterior end of each reservoir bends ventrally. These ducts lie one on either side of the oesophagus. They unite in the neck region under the longitudinal connectives of the ventral nerve cord to form one median duct. This single, salivary duct continues into the ventral side of the head, it passes under the brain and the infrabuccal sac, and it opens on the upper side of the labium.

Caste and Sex Differences of the Glands

Maxillary glands. The size of the maxillary glands differs in the small-sized, medium-sized, and large-sized workers (figs. 1, 2 and 3). The glands and the gland cells in the large-sized workers are larger, for the most part, than the glands and the majority

of the gland cells in the medium-sized workers. Similarly, the glands and the gland cells in medium-sized workers are generally larger than those in small-sized workers.

The maxillary glands of the queens are the largest. They occupy a large portion of the space in the head capsule anterior to the antennae (fig. 5). A greater number of cells and also an increase in the size of the individual cells account for this increased size of the maxillary glands in the queens. While some of the cells are small and may be even smaller than the large cells found in the large-sized workers, most are about one and a half times the size of those in the large-sized workers.

In the males,there is a reduction in the cell size and a noticeable reduction in the size of the maxillary glands (fig. 4). The glands and their cells are even smaller than those in the small-sized workers.

POST-PHARYNGEAL GLANDS. The post-pharyngeal glands in the different-sized workers are limited to the region of the brain (figs. 1, 2 and 3). In some individuals, a few of the glandular tubes may extend laterally and cover the optic nerves. In the large-sized worker the tubes extend slightly beyond the posterior border of the brain. In the medium-sized worker the tubes extend past the mid-section of the brain and a few of the lateral tubes may extend to the posterior border of the brain. In the small-sized worker only the anterior part of the brain is covered by the glandular tubes. There is no fat tissue around these glands in any of the workers.

The post-pharyngeal glands of the queens occupy a much greater portion of the head capsule than do those of the workers (fig. 5). In the queens, the tubes are larger and longer than in the workers; they cover the brain and optic nerves completely and extend below the optic nerves as well as above them. Some of the dorsally situated tubes extend almost to the posterior wall of the head capsule. Some of the laterally situated tubes extend to the eyes. Considerable fat tissue covers the gland and is situated between the individual glandular tubes.

In the males, the tubes extend beyond the mid-section of the brain (fig. 4) and they are a little larger than those in the small-sized workers. A fair amount of fat tissue is found in the head of the male. As is the case in the queen, fat tissue lies between the individual tubes of these glands.

The above observations of the post-pharyngeal glands in the various forms indicate the size of the glands in relation to the size of the brain. Another approach is a comparison of the size of the glands to the head size (the figures indicate this relationship). On this basis, the post-pharyngeal glands of the queen are again the largest. Again for the workers, there is a slight decrease in gland size from large-sized workers to small-sized workers. The size of the glands in the male falls between that of the medium- and small-sized workers; however, there is very little difference in these last three forms.

Salivary glands. In the small-sized, medium-sized, and large-sized workers, the salivary glands are well developed (figs. 1, 2 and 3). A large number of branched, glandular tubules are distributed along the entire length of the dorsolateral region of the prothorax, and a number of tubules continue dorsomedially from each side. A few of the posterior tubules are found in the anterior, lateral portion of the mesothorax. The reservoirs are large, they lie side by side in the median portion of the prothorax, and they run the entire length of the prothorax in all members of this caste. Usually, the posterior ends of the reservoirs extend into the mesothorax.

The salivary gland tubules of the queens are fewer in number than in the workers (fig. 5), and the reservoirs are comparatively smaller than those of the workers. The reservoirs are arranged close to the lateral walls of the prothorax, they are shifted anteriorly and to the side because of the well developed wing muscles in the mesothorax, and they lie completely within the prothorax.

The males, like the queens, show fewer tubules than the workers. The position of the tubules and the reservoirs is similar to that in the queens (fig. 4). The reservoirs in the males are smaller than those found in the small-sized workers.

DISCUSSION

The maxillary glands, the post-pharyngeal glands, and the salivary glands are present in the female castes and the male of *C. pennsylvanicus*. The sizes of these glands differ somewhat for the various forms.

The maxillary glands of the queens and workers of *Camponotus maculatus oasium, C. vagus, Cataglyphis bicolor, Oecophylla*

smaragdina, and *Atta sexdens* studied by Bugnion (1930) and the *C. pennsylvanicus* workers (Forbes, 1938) are similar in their size, position, and arrangement to the glands of the queens and workers observed in this study. However, a different arrangement of the ducts of these glands has been described for *Formica rufa, F. fuliginosa,* and *Myrmica ruginodis* (Meinert, 1861), for *F. rufa, M. rubra,* and *Lasius niger* (Janet, 1894, 1899, and 1905), for *L. flavus, L. niger,* and *M. ruginodis* (Lubbock, 1877), and for *Stigmatomma pallipes* and *Rhytidoponera convexa* (Whelden, 1957 a and b). In these species the individual gland cell ducts open separately on a small cribellum at either side of the buccal tube. Each cribellum opens into a short collecting duct. Maxillary glands are completely lacking in the queen of the parasitic ant, *Teleutomyrmex schneiderei* (Gösswald, 1953); these glands are lacking in both the queens and the males of *Anergates atratulus,* but they are present in all forms of this latter's host ant, *Tetramorium caespitum* (Meyer, 1955).

The post-pharyngeal glands in *F. rufa* workers (Meinert, 1861 and Janet, 1894) appear larger and seem to have more tubes and longer tubes than those observed in *C. pennsylvanicus.* Janet (1894) states that some of these tubes descend in front of the brain but the greater portion is stretched out above the brain; this is also true for *C. pennsylvanicus.* The post-pharyngeal glands of *M. ruginodis worker* (Meinert, 1861), *L. mixtus* worker, *L. niger* queen, and *M. rubra* worker (Janet, 1897, 1899, and 1905), and *C. bicolor* and *O. smaragdina* workers (Bugnion, 1930) correspond in size to these glands in the workers and queens of *C. pennsylvanicus.* The post-pharyngeal glands as pictured by Lubbock (1877) in *L. niger, L. flavus,* and *M. ruginodis* and in the workers of *L. flavus* (Nassonow, 1889) are likewise similar to those found in *C. pennsylvanicus.* Bugnion (1930) found these glands in the *Messor structor* queens to be completely different in form and extent. *Atta sexdens* queens have much smaller glands, *C. vagus* queens have somewhat smaller glands, and the glands of *C. maculatus oasium* workers are much larger than the glands in the female castes of *C. pennsylvanicus.* The previous description of these glands in *C. pennsylvanicus* workers (Forbes, 1938) agrees with the observations made for this caste in this study. Whelden's description of these glands in both *Stigmatomma pallipes* (1957 a) and *Rhytidopnera convexa* (1957 b) is similar to

that for *C. pennsylvanicus;* in *S. pallipes,* the tubules of these glands are larger and more numerous in the queens and smaller and fewer in the males than they are in the workers. Meyer (1955) reports these glands as normal in *Anergates atratulus* and its host, *T. caespitum.* In *T. caespitum* queen, they fill a large part of the head. Gösswald (1953) observed that the glands in the *Teleutomyrmex schneiderei* queen were smaller than those found in *T. caespitum.*

Meinert's (1861) illustration of the salivary glands of *F. rufa* worker is similar to the observation for *C. pennsylvanicus.* The number of tubules appears to be fewer than in *C. pennsylvanicus* worker. The location of the salivary glands in *M. rubra* queen and worker, in *L. niger* queen (Janet, 1898, 1899, 1904, 1905 and 1907), and in *C. pennsylvanicus* worker (Forbes, 1938) agrees with the present observations; however, the *M. rubra* queen and worker do not have salivary reservoirs. Gösswald (1953) reports these glands are reduced to a small, blind sac situated on the dorsal side of the oesophagus in *Teleutomyrmex schneiderei,* and Meyer (1955) observed in *A. atratulus* only occasional gland cells in the prothorax and no distinct excretory duct. In both *Stigmatomma pallipes* and *Rhytidoponera convexa* (Whelden, 1957 a and b), the glands are located in the ventral region of the thorax, and salivary reservoirs are absent. The salivary duct in *S. pallipes* appears fairly straight externally, but it has a long, twisted, folded central canal. In *R. convexa,* isolated fragments of the glands were found in the gaster. The salivary ducts in some individuals of this species travel forward separately in the head to the mouth while in others they unite in the neck region to form a single duct. These glands are reduced in the male of *R. convexa.*

Very little is really known about the activities of the glands studied in this paper although glands which are connected to or associated with the digestive tract are assumed to be digestive in function. Secretion vacuoles have been seen in the cytoplasm of maxillary gland cells (Forbes, 1938; Whelden, 1957 a and b); however, in the parasitic ants investigated by Gösswald (1953) and Meyer (1955) the maxillary glands are lacking. Thus, it might be assumed that, in addition to serving a digestive function, these glands may also play some part in trophallaxis. The postpharyngeal glands are present in all the ants so far investigated. Bugnion (1930) observed from his numerous dissections that the

pharynx and pharyngeal glands in the more primitive ants (ponerines and dorylines) were not as well developed as in the higher forms (camponotines, formicines, and myrmicines). He concluded that the better development in the case of the higher forms resulted from the feeding of the larvae by regurgitation, which he assumed the primitive forms did not do. Recent developments do not uphold this conclusion. It is now known that there is a transfer of ingluvial food from adults to larvae in some species of ponerines and even in two species of the primitive *Myrmecia* (Haskins and Whelden, 1954). On the other hand, these investigators have not observed this activity in the ponerine, *Stigmatomma pallipes,* although the post-pharwngeal glands are well developed, particularly in the female castes (Whelden, 1957 a). Janet (1897) observed that colored honey fed to workers of *Lasius mixtus* moved into some of the tubules of these glands and then left the tubules as more uncolored honey was fed to the workers. Secretion granules have been reported in the cytoplasm of the cells of these glands (Bugnion, 1930; Forbes, 1938; Whelden, 1957 a and b), and Bugnion suggested that a nutritive substance was added at the moment of disgorgement. On the basis of Janet's observation and considering that these glands are present in all ants, a better suggestion might be that a substance which aids in digestion is added when the food is taken in. These glands probably serve the digestive activities of the individual ant.

The salivary glands are not present in the two species of parasitic ants investigated, but they are present in all other species. These glands are well developed in the female castes and less well developed in males. They are best developed in the worker castes in *C. pennsylvanicus.* Bernard (1951) believes these glands are probably concerned with feeding the larvae and rearing the brood and that they might produce a specific nutrient material. These observations indicate that these glands may play an important role in trophallaxis.

SUMMARY

1. The anatomy of the maxillary glands, the post-pharyngeal glands, and the salivary glands is described for the female castes and the male of the black carpenter ant, *Camponotus pennsylvanicus.*

2. The maxillary glands and maxillary gland cells differ somewhat in size in the queen, the workers, and the males. The size decreases in the following order: queen, large-sized worker, medium-sized worker, small-sized worker, and male.

3. The post-pharyngeal glands attain a remarkably large size in the queen and occupy most of the head capsule. In the workers there is a slight reduction in the gland size from the large-sized worker to the medium-sized worker, and again to the small-sized worker. The size of the glands for the male lies between that of the medium-sized worker and the small-sized worker. Fat tissue covers the glands in both the queen and the male.

4. The salivary glands in all three types of workers show well developed reservoirs and a large number of tubules. In the queen and the male there is a reduction in size of the reservoir and also in the number of tubules present.

5. Comparisons are made between the glands in *Camponotus pennsylvanicus* and the other reported genera and species.

6. All these glands probably serve a digestive function for the individual ants. The maxillary and salivary glands may play an important role in trophallaxis.

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TOXORHYNCHITES RUTILUS AND ANOPHELES BARBERI IN NEW YORK CITY (DIPTERA, CULICIDAE)

BY ALEXANDER B. KLOTS
THE CITY COLLEGE OF NEW YORK

On 3 November 1960 a nearly mature larva of *Toxorhynchites rutilus* (Coquillett) was collected in water in a tree hole in Pelham Bay Park, New York City, during a field trip of the City College Field Zoology class. The tree hole was near the base of a Sweet Gum (*Liquidambar styraciflua* L.). The water in it was very dark brown and almost as opaque as it could be. The larva pupated on 18 November. Unfortunately the pupa was damaged and died; but the identification, made by comparison of the larval exuvium and the pupa with specimens collected by the writer in North Carolina and Florida, may be accepted as safe. Since Jenkins (1949) gives only two records of the species from New Jersey and one from Pennsylvania, the record seems to be an important one.

In the same tree hole were more than two hundred larvae of *Anopheles barberi* (Coquillett) in the penultimate stadium. Brought indoors, these developed with no sign of a diapause. At the time of writing (2 January 1961) nearly all are mature, or have transformed to pupae or adults. The distribution northward of this species is not well known, although it has been recorded from Ithaca, N. Y. It is a potential, although improbably important, vector of malaria.

Associated with these mosquito larvae were a few larvae of a rat-tailed maggot, *Tubifera* sp., probably *tenax* (L.) (= *Eristalis* Latreille) and a considerable number of beetle larvae, of the family Helodidae (det. J. T. Rozen, Jr.). The latter seemed to form the chief food of the *Toxorhynchites* larva. No larvae were found of our usual tree hole species, *Aedes triseriatus* (Say) and *Orthopodomyia signifera* (Coquillett).

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AN ANNOTATED LIST OF THE LYCAENIDAE (LEPIDOPTERA: RHOPALOCERA) OF THE WESTERN HEMISPHERE

BY WILLIAM PHILLIPS COMSTOCK AND EDGAR IRVING HUNTINGTON

[Continued]

labecula Watson, Frank E. and William P. Comstock, *Plebeius acmon*
Type Locality: San Francisco, California; Nevada.
Location of Type: American Museum of Natural History.
Original Description: 1920, Bull. Amer. Mus. Nat. Hist., vol. 42, p. 457 (New York, N. Y.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 28, no. 459 (Los Angeles, Calif.). (Places *labecula* as an aberration of *acmon cottlei* Grinnell.)

labes Druce, Hamilton H., *Thecla*
Type Locality: Cunapo, Trinidad, B .W. I., June 21.
Location of Type: Druce Collection.
Original Description: 1907, (June), Proc. Zool. Soc. London, p. 602, pl. 36, fig. 6 ♂ (London).

laceyi Barnes, William and James H. McDunnough, *Callicista*
Type Locality: Del Rio, Texas.
Location of Type: United States National Museum.
Original Description: 1910 (November), Can. Ent., vol. 42, p. 365 ♀ (London, Ont.).
Additional Reference: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 88 (New York). (Recognize *laceyi* as a species related to *clytie* Edwards; not a synonym of *columella* Fabricius (Holland, W. J., 1931, The Butterfly Book, p. 240).
Synonyms: *lacyi* (Zool. Record).

laconia Hewitson, W. C., *Thecla*
Type Locality: Amazon.
Location of Type: British Museum (Natural History).
Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 10 (London).
Additional Reference: Hewitson, W. C., 1873 (February), Illus. of Diurnal Lepidoptera, vol. 1, p. 150, vol. 2, pl. 59, figs. 388, 389 ♂ (London). Amazon, Pará.

lacustris Freeman, T. N., *Plebeius aquilo* var.
Type Locality: Norway House, Manitoba, June 28, 1938.

Location of Type: Canadian National Collection, Ottawa, no. 4521.
Original Description: 1939, Can. Ent., vol. 71, p. 180 (Orillia, Ont.).

lacyi, Callicista Misspelling of *laceyi* Barnes and McDunnough
Type Locality:
Location of Type:
Original Description: 1911, Zool. Record, vol. 47, p. 321 (Insecta) (London).

ladon Cramer, Pierre, *Papilio*
Type Locality: Cape of Good Hope.
Location of Type:
Original Description: 1780, Papillons exotiqués des trois parties du monde, vol. 3, p. 141, pl. 270, figs. D, E (Amsterdam).
Note: An African species, *ladon* auctorum = *pseudargiolus* Boisduval and LeConte.

laeta Edwards, William H., *Thecla*
Type Locality: London, C. W. (♂).
Location of Type:
Original Description: 1863, Proc. Acad. Nat. Sci., Philadelphia, p. 55 (Philadelphia, Pa.).
Synonyms: *clothilde* Edwards.

lampetia Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Cache, Costa Rica.
Location of Type: British Museum (Natural History).
Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 83 (London).

lanckena Schaus, William, *Thecla*
Type Locality: Peru.
Location of Type: United States National Museum, no. 5955.
Original Description 1902, Proc. U. S. Natl. Mus., vol. 24, p. 422 (Washington, D. C.).

lanoraieensis Sheppard, A. C., *Incisalia*
Type Locality: Lanoraie, Prov. Quebec (40 miles E. of Montreal), Canada, May 21, 1933.
Location of Type: Canadian National Collection, Ottawa, Ontario.
Original Description: 1934 (June), Can. Ent., vol. 66, no. 6, p. 141.

laothoë Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Guatemala (Polochic Valley), Parula, Senahu.
Location of Type: British Museum (Natural History).
Original Description: 1887 (May), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 25, vol. 3, pl. 50, figs. 26, 27 ♂ (London).

larseni Lathy, Percy I., *Thecla*
Type Locality: Mendoza, Argentina.
Location of Type: Fournier Collection, Paris.

Original Description: 1936, Livre jubilaire de M. Eugène-Louis Bouvier, p. 230, pl. 8, fig. 7 (Paris).

latagus Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Chiriquí, Panamá.
Location of Type: Staudinger Collection.
Original Description: 1887 (August), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 58, vol. 3, pl. 55, figs. 9, 10 ♂ (London).

latreillii Hewitson, W. C., *Thecla*
Type Locality: "Java". Draudt gives Brazil to Paraguay.
Location of Type: British Museum (Natural History).
Original Description: 1865, Illus. of Diurnal Lepidoptera, vol. 1, p. 74, vol. 2, pl. 29, figs. 8, 9 ♂ (London).

laudonia Hewitson, W. C., *Thecla*
Type Locality: Amazon.
Location of Type: British Museum (Natural History).
Original Description, 1867, Illus. of Diurnal Lepidoptera, vol. 1, pp. 77, vol. 2, pl. 45, figs. 191, 192 ♂ (London).

lausus Cramer, Pierre, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1779, Papillons exotiques des trois parties du monde ,vol. 3, p. 70, pl. 233, fig. E (Amsterdam).
Additional Reference: Godman, F. D. and O. Salvin, 1887 (August), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 54, vol. 3, pl. 54, fig. 23 ♀ (Nicaragua) (London).
Synonyms: *libanius* Cramer.

lauta Draudt, Max, *Thecla ortygnus* form
Type Locality: Deserts of Guerrero, Mexico.
Location of Type:
Original Description: 1919 (December), The Macrolepidoptera of the World, vol. 5, p. 768, pl. 152-a (Stuttgart).

lebena Hewitson ,W. C., *Trecla*
Type Locality: Cayenne.
Location of Type: British Museum (Natural History).
Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 9 (London).
Additional References: Hewitson, W. C., 1869 (April), Illus. of Diurnal Lepidoptera, vol. 1, p. 127, vol. 2, pl. 51, figs. 266, 267 ♂ (London). Druce, H. H., 1907 (June), Proc. Zool. Soc. London, p. 631 (London). (Makes *lebena* a synonym of *eryx* Cramer.)

leda Edwards, William H., *Thecla*
Type Locality: Near Prescott, Arizona (2 ♂♂).

Location of Type: Carnegie Museum, Pittsburgh, Pennsylvania.

Original Description: 1882 (February), Papilio, vol. 2, p. 23 (New York).

Additional References: Godman, F. D. and O. Salvin, 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 91 (London), add locality Northern Sonora, Mexico. Barnes, William and J. H. McDunnough, 1912 (July), Contributions to the Natural History of the Lepidoptera of North America, vol. 1, no. 4, p. 57, pl. 27, figs. 1, 2, 4 (Decatur, Illinois). Holland, W. J., 1931, The Butterfly Book, 2nd Edition, p. 240, pl. 64, figs. 37 ♂ (type), 38 ♀ (Garden City, N. Y.). (This probably fixes the lectotype.)

Synonyms: *ines* Edwards (winter form).

ledaea Hewitson, W. C., *Thecla*

Type Locality: Amazon (Ega).

Location of Type: British Museum (Natural History).

Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 8 (London).

Additional Reference: Hewitson, W. C., 1869 (April), Illus. of Diurnal Lepidoptera, vol. 1, p. 131, vol. 2, pl. 52, figs. 293, 294 (London).

legionis Clench, Harry K., *Thecla*

Type Locality: Blumenau, Sta. Catharina, Brazil (♀).

Location of Type: Museum of Comparative Zoology, no. 26,225.

Original Description: 1944 (July), Bull. Mus. Comp. Zool., vol. 94, p. 240 (Cambridge, Mass.).

legota Hewitson, W. C., *Thecla*

Type Locality: Bolivia.

Location of Type: British Museum (Natural History).

Original Description: 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 205, vol. 2, pl. 81, figs. 676, 677 (London).

legytha Hewitson, W. C., *Thecla*

Type Locality: Nicaragua (Chontales).

Location of Type: British Museum (Natural History).

Original Description: 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 180, vol. 2, pl. 71, figs. 537, 538 ♂ (London).

Additional Reference: Godman, F. D. and O. Salvin, 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 79 (London). (Make *legytha* a synonym of *emessa* Hewitson.)

lemnos Druce, Hamilton H., *Thecla*

Type Locality: Interior of Colombia.

Location of Type: Druce Collection (♂).

Original Description 1890, Ent. Mo. Mag., Series 2, vol. 1, p. 152 (London).

lemona Hewitson, W. C., *Thecla*

Type Locality: Brazil.

Location of Type: British Museum (Natural History).

Original Description: 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 177 ,vol. 2, pl. 69, figs. 519, 520 ♀ (London).

lemuria Hewitson, W. C., *Thecla*
Type Locality: Amazon.
Location of Type: British Museum (Natural History).
Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 10 (London).
Additional Reference: 1873 (February), Illus. if Diurnal Lepidoptera, vol. 1, p. 149, vol. 2, pl. 59, figs. 382, 383 ♂ (London). Amazon (Pará).

lenis Capronnier, J. B., *Thecla*
Type Locality: Itaipú, Brazil, October 6.
Location of Type:
Original Description: 1874, Ann. Soc. Ent. Belgique, vol. 17, p. 16, pl. 1, fig. 3 (Bruxelless).
Additional Reference: Druce, H. H., 1907 (June), Proc. Zool. Soc. London, p. 620 (London). (Makes *lenis* (♀) a synonym of *una* Hewitson.)

lenitas Druce, Hamilton H., *Thecla*
Type Locality: Chapada Campo, Brazil and Paraguay. Brazil specimens January and February.
Location of Type: Godman Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 603, pl. 36, fig 5 ♂ (London).

leos Schaus, William, *Thecla*
Type Locality: Guapiles, La Florida, Costa Rica.
Location of Type: British Museum (Natural History).
Original Description: 1913 (September), Proc. Zool. Soc. London, p. 353, pl. 52, fig. 7 ♂ (London).

leptocosma Hayward, Kenneth J., *Thecla bicolor* form
Type Locality: Zapala, Nuequén, Argentina, December 31, 1936.
Location of Type: Fundacion Miguel Lillo, Tucumán.
Original Description: 1949, Acta Zool, Lilloana, vol. 8, p. 578 (Tucumán, Argentina).

leucogyna Felder, Cajetan and Rudolf Felder, *Pseudolycaena*
Type Locality: Venezuela and New Granada, Bogotá.
Location of Type:
Original Description: 1864–1867, Reise der Osterreichischen Fregatta "Novara" um die Erde, vol 2, p. 245, pl. 31, figs. 16, 17 ♂, 18 ♀ (Wien).

leucophaeus Hübner, Jacob, *Rusticus*
Type Locality: Brazil.
Location of Type:
Original Description: 1808, Erste Zuträge zur Sammlung exotischer Schmettlinge, p. 5, nos. 87, 88 (Augsburg). (Nomen nudum.)
Additional References: Hübner, Jacob, 1809–1813, *op. cit.*, figs. 87, 88. (Verification of name.); 1818, *op. cit.*, vol. 1, p. 18 (As *Bithys leucophaeus.*)
Synonyms: *halala* Hewitson, *parvinotus* Kaye.

leussleri Gunder, Jean D., *Plebeius saepiolus* tr. f.
Type Locality: Cassel's Park County, Nebraska, Alt. 8500 ft., August 23, 1918.
Location of Type: Leussler Collection.
Original Description: 1927 (December), Can. Ent., vol. 59, p. 282, pl. A, fig. 3 (Orillia, Ont.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 27, no. 453 (Los Angeles, Calif.). (Places *leussleri* as an aberration of *saepiolus* Boisduval.)

leussleri Gunder, Jean D., *Glaucopsyche lygdamus oro* tr. f.
Type Locality: Harrisburg, Banner County, Nebraska, August, 23, 1918.
Location of Type: Leussler Collection.
Original Description: 1927 (December), Can. Ent., vol. 59, p. 283, pl. A, fig. 8 (Orillia, Ont.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 28, no. 473 (Los Angeles, Calif.). (Places *leussleri* as an aberration of *lygdamus couperi* Grote.)

levis Druce, Hamilton H., *Thecla*
Type Locality: Pará, Amazonas, Brazil.
Location of Type: British Museum (Natural History).
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 598, pl. 35, fig. 14 ♂ (London).

libanius Cramer, Pierre, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1784, Papillons exotiques des trois parties du monde, vol. 4, p. 177, pl. 379, figs. H, I. (Amsterdam).
Additional Reference: Kirby, W. F., 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 388 (London). (Makes *libanius* ♀ a synonym of *lausus* Cramer.)

ligia Hewitson, W. C., *Thecla*
Type Locality: Santa Martha.
Location of Type: British Museum (Natural History).
Original Description: 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 204, vol. 2, pl. 81, figs. 670 ♂, 671, 672 ♀ (London).

ligurina Hewitson, W. C., *Thecla*
Type Locality: Nicaragua (Chontales).
Location of Type: British Museum (Natural History).
Original Description: 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 181, vol. 2, pl. 71, figs. 541, 542 ♀ (London).
Additional Reference: Godman, F. D. and O. Salvin, 1887 (June), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 44, vol. 3, pl. 53, figs. 15, 16 ♂ (London) (Polochic Valley, Guatemala).

lilacina Lathy, Percy I., *Thecla*
Type Locality: Petropolis, Brazil, February, 1874 2 ♂♂.

Location of Type: Fournier Collection, Paris.
Original Description: 1930 (June), Trans. Ent. Soc. London, p. 136, pl. 9, fig. 13 ♂ (London).

limenia Hewitson, W. C., *Thecla*
Type Locality: Jamaica.
Location of Type: British Museum (Natural History).
Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 32 (London).
Additional References: Hewitson, W. C., 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 160, vol. 2, pl. 63, figs. 431, 432 ♀ (London) (Santo Domingo, Cuba). Comstock, W. P. and E. I. Huntington, 1943, (December), Ann. New York Acad. Sci., vol. 45, p. 86 (New York, N. Y.)

lincoides Draudt, Max, *Thecla togarna* form
Type Locality: Colombia and Ecuador.
Location of Type:
Original Description: 1919, The Macrolepidoptera of the World, vol. 5, p. 757, pl. 150-c (Stuttgart).
Additional Reference: Hewitson, W. C., (Illus. of Diurnal Lepidoptera, vol. 1, p. 85, vol. 2, pl. 33, figs. 50, 51 ♂) figures this as *lincus* Fabricius.

lincus Fabricius, Johann Christian, *Hesperia*
Type Locality: Surinam.
Location of Type:
Original Description 1793, Entomologica Systematica, vol. 3, p. 289 (Hanfiae).
Note: *lincus* Fabricius is a synonym of *aetolus* Sulzer.

lineata Lathy, Percy I., *Thecla*
Type Locality: Balzapamba, Ecuador.
Location of Type: Fournier Collection, Paris.
Original Description: 1936, Livre jubilaire de M. Eugéne-Louis Bouvier, p. 231, pl. 8, fig. 14 (Paris).

linus Fabricius, Johann Christian, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1777, Gen. Ins., p. 269 (Chilonii).
Additional Reference: Roemer, Joanne Jacobs, 1789, Gen. Ins. Linn. et Fabr. Icon. Ill., p. 71, pl. 19, figs. 10, 11 Vitoduri Helvetorum. (In this reprint of Sulzer's plates Roemer changed the name of *aetolus* Sulzer to *linus* Fabricius.)
Note: The name *linus* Fabricius is a synonym of *aetolus* Sulzer.

liparops Boisduval, Jean A. and John LeConte, *Thecla*
Type Locality: Georgia.
Location of Type:
Original Description: 1833, Histoire Générale et iconographie des Lépidoptères et des chenilles de l'Amérique Septentrionale, p. 99, pl. 31 (Paris.)
Additional Reference: Michener, C. D. and C. F. dos Passos, 1942, Amer.

Mus. Novitates, no. 1210, p. 2 (New York, N. Y.). Place *liparops* with *favonius* Abbot and Smith.)

Note: W. T. M. Forbes has in the Cornell Collection a specimen which has orange spots on the upperside of the forewings and is marked like *strigosa* on the underside; the specimen is from Georgia.

liparops Fletcher, James, *Thecla strigosa* var.

Type Locality: Localities in Manitoba, Canada.

Location of Type: United States National Museum.

Original Description: 1903, Trans. Royal Soc. Canada, Section 4, p. 210, figs. (Ottawa, Ont.).

Additional References: Fletcher, James, 1904 (May), Can. Ent., vol. 26, p. 124, pl. (London, Ont.). Michener, C. D. and C. F. dos Passos, 1942 (November), Amer. Mus. Novitates, no 1210, p 3 (New York, N. Y.). (Make a new name, *Strymon strigosus fletcheri* for *Thecla strigosa* var. *liparops* Fletcher which is a homonym.)

lisus Stoll, Caspar, *Papilio*

Type Locality: Surinam.

Location of Type:

Original Description: 1790, Papillons exotiques des trois parties du monde, Supplement, p. 167, pl. 38, figs. 2, 2B (Amsterdam).

Synonyms: *hisbon* Godman and Salvin.

lita Hayward, Kenneth J., *Thecla ocrisia*

Type Locality: Tucumán, Argentina.

Location of Type: Fundación Miguel Lillo, Tucumán. (Several specimens in the British Museum (Natural History).

Original Description: 1949, Acta Zool. Lilloana, vol. 8, p. 570 Tucumán, Argentina).

literatus Druce, Hamilton H., *Thecla*

Type Locality: San José, Paraguay.

Location of Type: Druce Collection.

Original Description: 1907 (June), Proc. Zool. Soc. London, p. 588, pl. 34, figs. 13 ♂, 14 ♀ (London).

loki Skinner, Henry, *Thecla*

Type Locality: Mt. Springs, San Diego County, California, July 5, 1906.

Location of Type: Academy of Natural Sciences, Philadelphia, Pennsylvania.

Original Description: 1907 (November), Ent. News, vol. 18, p. 378 (Philadelphia, Pa.).

lollia Godman, F. D. and O. Salvin, *Thecla*

Type Locality: Irazú, Costa Rica.

Location of Type: British Museum (Natural History).

Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, 85, vol. 3, pl. 57, figs. 26, 27 ♂ (London).

longinus Nabokov, V., *Lycaeides argyrognomon*

Type Locality: Jackson's Hole, N. W. Wyoming, July 26, 1900.

Location of Type: Museum of Comparative Zoology, Cambridge, Massachusetts.

Original Description: 1949 (February), Bull. Mus. Comp. Zool., vol. 101, no. 4, p. 516, pl. 1, fig. 31, pl. 8, fig. 106 (Cambridge, Mass.).

longula Hewitson, W. C., *Thecla*

Type Locality: Mexico.

Location of Type: British Museum (Natural History).

Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 34 (London).

Additional References: Hewitson, W. C., 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 200, vol. 2, pl. 80, figs. 651, 652 ♀, 653, 654 ♂ (London). New Granada, Ecuador and Bolivia. Clench, Harry K., 1944, Bull. Mus. Comp. Zool., vol. 94, p. 239 (Cambridge, Mass.). Godman, F. D. and O. Salvin, Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 3, pl. 52, figs. 8–10 (as *pastor*) are *longula* Hewitson.

Note: Hewitson's figures 651–654 show *pseudolongula* Clench. Hewitson's description (1868) does not agree with these figures.

longuloides Clench, Harry K., *Thecla*

Type Locality: Coroico, Bolivia, May, 1899.

Location of Type: Museum of Comparative Zoology, no. 26,224.

Original Description: 1944 (July), Bull. Mus. Comp. Zool., vol. 94, p. 237 (Cambridge, Mass.).

lophis Druce, Hamilton H., *Thecla*

Type Locality: El Tigre, Rîo Tanana, Chocó, Colombia, 320 ft.

Location of Type: Druce Collection (♂).

Original Description: 1912 (June), Ent. Mo. Mag., Series 2, vol. 23, p. 131, pl. X, fig. 1 ♂ (London).

lorata Grote, Augustus R. and Coleman T. Robinson, *Thecla*

Type Locality: "Atlantic District", Virginia.

Location of Type: American Museum of Natural History.

Original Description: 1867 (July), Trans. Amer. Ent. Soc., vol. 1, p. 171 (Philadelphia, Pa.).

Additional Reference: Barnes, William and J. H. McDonnough, 1916, Contributions to the Natural History of the Lepidoptera of North America, vol. 3, no. 2, p. 104 (Decatur, Illinois). (Show that *lorata* was an artifact and a specimen of *calanus* Auctorum-*falacer* Godart.)

lorea Möschler, H. B., *Thecla*

Type Locality: Interior of Surinam.

Location of Type:

Original Description: 1883, Verh. Zool.-Bot. Ges., vol. 32, p. 309, pl. 17, fig. 3 (Wien).

lorina Hewitson, W. C. *Thecla*

Type Locality:

Location of Type: British Museum (Natural History).

Original Description: 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 181, vol. 2, pl. 71, figs. 539, 540 ♂ (London).

Additional Reference: Druce, H. H., 1907 (June), Proc. Zool. Soc. London, p. 610 (London). (Says that type may have come from Venezuela and that it is a female.)

lorquini Behr, Hermann, *Lycaena*

Type Locality: Higher Sierra Nevada, California.

Location of Type:

Original Description: 1867 (January), Proc. Calif. Acad. Nat. Sci., vol. 3, p. 280 (San Francisco, Calif.).

Note: The species described by Behr as *lorquini* was *piasus* Boisduval. The name was preoccupied by *Lycaena lorquinii* Herrich-Schäffer, a European species.

lorquini Field, William D., *Habrodias grunus*

Type Locality: Mount Diablo, Contra Costa County, California, August 1, 1932.

Location of Type: F. Martin Brown Collection, Colorado Springs, Colorado.

Original Description: 1938, Bull. Southern Calif. Acad. Sci., vol. 37, pt. 1, p. 27 (Los Angeles, Calif.).

Synonyms: *chloris* Field.

lotis Lintner, J. A., *Lycaena*

Type Locality: Mendocino, California.

Location of Type:

Original Description: 1879, 30th Ann. Rept. New York State Mus. Nat. Hist., p. 169 (Albany, N. Y.).

Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 27, no. 450 (Los Angeles, Calif.). (Places *lotis* as a subspecies of *melissa* Edwards.)

lotis Goodson, F. W., *Thecla*

Type Locality: San Estebán, Venezuela, July, 1909 (1 ♂, 1 ♀). Las Quiguas, Esteban Valley, N. Venezuela, "November–March, 1910" (1 ♂, 1 ♀). Venezeula, ex Druce Coll. (2 ♂).

Location of Type: British Museum (Natural History).

Original Description: 1945 (December), Entomologist, vol. 78, p. 185 (London).

loxurina Felder, Cajetan and Rudolf Felder, *Thecla*

Type Locality: New Granada, Bogotá.

Location of Type:

Original Description: 1864–1867, Reise der Osterreichischen Fregatte "Novara" um die Erde, vol. 2, p. 262, pl. 32, figs. 21, 22 (Wein).

Subspecies: *atymnides* Draudt, *quadrufus* Hayward *quindiensis* Draudt, *rufanalis* Hayward.

lucagus Godman, F. D. and O. Salvin, *Thecla*

Type Locality: Jalapa, Mexico.

Location of Type: British Museum (Natural History).

Original Description: 1887 (September), Biologia Centrali-Americana,

Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 86, vol. 3, pl. 57, figs. 30, 31 ♂ (London).

lucania Hewitson, W. C., *Thecla*
Type Locality: Mexico.
Location of Type: British Museum (Natural History).
Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 33 (London).
Additional Reference: Hewitson, W. C., 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 205 (London). (Hewitson makes *lucania* a synonym of *herodotus* Fabricius.)

lucaris Weeks, A. G., Jr., *Thecla*
Type Locality: Cusilluni, Bolivia, May, 1899.
Location of Type: Museum of Comparative Zoology.
Original Description: 1901 (December), Proc. N. E. Zool. Club, vol. 2, p. 102 (Cambridge, Mass.).
Additional References: Weeks, A. G. Jr., 1905, Illus. of Diurnal Lepidoptera, p. 42, pl. 10, fig. 1 (Boston, Mass.). Druce, H. H., 1907 (June), Proc. Zool. Soc. London, p. 623 (London). (Makes *lucaris* a synonym of *rufo-fusca* Hewitson)
Note: It is probably a subspecies.

lucena Hewitson, W. C., *Thecla*
Type Locality: Venezuela.
Location of Type: British Museum (Natural History).
Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 26 (London).
Additional Reference: Hewitson, W. C., 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 154, vol. 2, pl. 61, figs., 406, 407 ♂ (London).

lucia Kirby, William, Rev., *Polyommatus*
Type Locality: "Taken in Latitude 54 deg." (Cumberland-house?)
Location of Type:
Original Description: 1837, Fauna Boreali-Americana; Zoology, British America (by Dr. John Richardson), pt. 4, Insects (by Rev. William Kirby), p. 299, pl. 3, figs. 8, 9 (Norwich, England).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 28, no. 475 (Los Angeles, Calif.). (Places *lucia* as a subspecies of *pseudargiolus* Boisduval and LeConte.)
Synonyms: *intermedia* Strecker.

luctuosa Watson, Frank E. and William P. Comstock, *Heodes xanthoides*
Type Locality: Tehachapi, California.
Location of Type: American Museum of Natural History.
Original Description: 1920, Bull. Amer. Mus. Nat. Hist., vol. 42, p. 453 (New York, N. Y.).

ludicra Weymer, Gustav, *Lycaena*
Type Locality: Tacora, Bolivia, 3600–4600 m.

Location of Type:

Original Description: 1890, Stubel's Reise (Lepidoptera Gessamelt auf einer Reise durch Colombia, etc.), p. 122, pl. 4, fig. 3 (Berlin).

lugubris Möschler, H. B., *Thecla*

Type Locality: Inner Surinam and Colombia (3 ♀).

Location of Type:

Original Description: 1876, Verh. Zool.-Bot. Ges., vol. 26, p. 301, pl. 3, fig. 4 (Wien).

Additional Reference: Godman, F. D. and O. Salvin, 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 72 (London). (Say that *lugubris* is the southern form of *hesperitis* Butler and Druce.) Druce, H. H., 1907 (June), Proc. Zool. Soc. London, p. 607 (London). (Makes *lugubris* a synonym of *hesperitis* Butler and Druce.) Draudt, Max, 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 794 (Stuttgart). (Accepts *lugubris* as the southern form of *hesperitis* Butler and Druce.)

Synonyms: *cabiria* Hewitson.

lupini Boisduval, Jean A., *Lycaena*

Type Locality: Southern California.

Location of Type: United States National Museum?

Original Description: 1869, Ann. Soc. Ent. Belgique, vol. 12, p. 46 (Bruxelles).

Additional References: Oberthür, Charles, 1913 (October), Etudes de Lepidopterologie Comparee, fasc. 9, pt. 1, p. 42, pl. 238, figs. 1961 ♂, 1962 ♀ (Rennes). Draudt, Max, 1921 (January), The Macrolepidoptera of the World, vol. 5, p. 817 (Stuttgart). (Incorrectly gives Behr as the author of *lupini*.)

Synonyms: *immaculata*. Chermock.

Subspecies: *spangelatus* Burdick.

lutzi Huntington, E. Irving, *Thecla*

Type Locality: Barro Colorado Island, Panama Canal Zone, December 2, 1930.

Location of Type: American Museum of Natural History.

Original Description: 1932, Bull. Amer. Mus. Nat. Hist., vol. 63, p. 212, fig. 1 (New York, N. Y.).

lutzi dos Passos, Cyril F., *Plebeius acmon*

Type Locality: Snowslide Canyon, eight miles from Montpelier, Idaho, July 10, 1929.

Location of Type: American Museum of Natural History.

Original Description: 1938 (March), Can. Ent., vol. 70, no. 3, p. 48, pl. 2, figs. 9–12 (Orillia, Ont.).

lycabas Cramer, Pierre, *Papilio*

Type Locality: Surinam.

Location of Type:

Original Description: 1777, Papillons exotiques des trois parties du monde, vol. 2, p. 31, pl. 117, fig. E (Amsterdam).

Additional Reference: Druce, H. H., 1907 (June), Proc. Zool. Soc. Lon-

don, p. 568 (London). (Did not recognize the species.)
Synonyms: *terentia* Hewitson.

lycea Edwards, William H., *Lycaena*
Type Locality: Rocky Mountains.
Location of Type:
Original Description: 1864 (March), Proc. Ent. Soc. Phila., vol. 2, p. 507 (Philadelphia, Pa.).
Additional References: Edwards, W. H., 1871 (March), Trans. Amer. Ent. Soc., vol. 3, p. 273 (Philadelphia, Pa.). (Describes the female from Colorado). McDunnough, J. H., 1938, Check list, pt. 1, p. 27, no. 455 (Los Angeles, Calif.). (Places *lycea* as a subspecies of *icarioides* Boisduval.)
Synonyms: *rapahoe* Reakirt.

lycimna Hewitson, W. C., *Thecla*
Type Locality: None given.
Location of Type: British Museum (Natural History).
Original Description: 1868, Specimen of a Catalogue of Lycaenidae in the British Museum, p. 33 (London).
Additional References: Hewitson, W. C., 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 203, vol. 2, pl. 80, figs. 663, 664 ♂, 665 ♀ (London). Draudt, Max, 1919 (December), The Macrolepidoptera of the World, vol. 5, p. 763 (Stuttgart). (Makes *lycimna* a synonym of *acaste* Prittwitz.)

lycus Skinner, Henry, *Thecla* (not Hübner)
Type Locality:
Location of Type:
Original Description: 1898, Synonymic Catalogue of North American Rhopalocera, p. 48 (Philadelphia, Pa.).
Additional Reference: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 73 (New York). (Place *lycus* in synonymy of *simaethis* Drury.)

lyde Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Polochic Valley, Guatemala.
Location of Type: British Museum (Natural History).
Original Description: 1887 (June), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 44, vol. 3, pl. 53, fig. 17 ♂ (London).

lydia Kirby, W. F., *Thecla*
Type Locality. Pará.
Location of Type:
Original Description: 1871, A synonymic Catalogue of Diurnal Lepidoptera, p. 393, no. 230 (London). (Substituted *lydia* for the name *Thecla timaea* Hewitson.)
Additional Reference: Draudt, Max, 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 777 (Stuttgart). (Places *lydia* and *timaea* in the synonymy of *spurina* Hewitson.)

lydus Hübner, Jacob, Bithys
Type Locality:
Location of Type:
Original Description: 1819, Verzeichniss bekannter Schmettlinge, p. 75 (Augsburg).
Note: This is a new name for *Papilio eryx* Cramer which is a homonym.
Synonyms: *eryx* Cramer, *ingae* Sepp syn., *lebena* Hewitson syn.
Subspecies: *occidentalis* Lathy.

lygdamas Edwards, William H., *Lycaena* (not Doubleday) Misspelling of *lygdamus* Doubleday
Type Locality:
Location of Type:
Original Description: 1869 (May), The Butterflies of North America, vol. 1, Lycaena, 1, p. 2 (Philadelphia, Pa.)

lygdamus Doubleday, Edward, *Polyommatus*
Type Locality: Pine forests of Georgia.
Location of Type: British Museum (Natural History).
Original Description: 1841 (December), Entomologist, no. 14, p. 209 (London).
Synonyms: *lygdamas* Edwards, *lygdarnus* Scudder.
Subspecies: *mildredae* Chermock, *nittanyensis* Chermock, *oro* Scudder, *arizonensis* McDunnough, *australis* Grinnell, *sinepunctata* Comstock syn., *sinepuncta* McDunnough syn., *behrii* Edwards, *sternitzkyi* Gunder syn., *columbia* Skinner, *couperi* Grote, *leussleri* Gunder syn., *mcdunnoughi* Gunder syn.

lygdarnus Scudder, Samuel H., *Lycaena* (not Doubleday) Misspelling of *lygdamus* Doubleday
Type Locality:
Location of Type:
Original Description: 1872, A systematic revision of some of the American Butterflies; with brief notes on those known to occur in Essex County, Mass., p. 33 (Salem, Mass.).

lyrnessa Hewitson, W. C., *Lycaena*
Type Locality: Chile.
Location of Type: British Museum (Natural History).
Original Description: 1874, Ent. Mo. Mag., vol. 11, p. 107 (London).
Additional Reference: Draudt, Max, 1921 (January), The Macrolepidoptera of the World, vol. 5, p. 822 (Stuttgart). (Makes *lyrnessa* synonym of *collina* Philippi.)

lysippus Linnaeus, Carolus, *Papilio plebeji rurales* (*Riodinidae*)
Type Locality: America.
Location of Type:
Original Description: 1758, Systema naturae, vol. 1, p. 484, no. 160 (Holmiae).
Additional Reference: Morris, John G., 1860 (May), Catalogue of the Described Lepidoptera of North America, p. 12 (Washington, D. C.). (Lists *lysippus* in Lycaenidae in error.)

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The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 79th St., & Central Park W., New York 24, N. Y.

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CHANGE OF JOURNAL EDITOR

With the publication of the June issue of this volume of the JOURNAL, the New York Entomological Society lost the services of Doctor William S. Creighton as its Editor. A change in the retirement regulations governing the faculties of the New York City Colleges during the early spring of this year has given Doctor Creighton the opportunity to take advantage of an early retirement from his teaching position at the College of the City of New York. He plans to continue active research on problems in the taxonomy and the biology of ants, for which he is so well-known. Because the ants in the southwestern region of the United States are to be his first target, he is leaving New York City. His participation at the meetings of the Society will be sorely missed.

The Society is grateful to him for his energetic and conscientious efforts as Editor and regrets that his tenure of this post was cut short. Although we are sorry to part with his presence and services, we are happy that a competent and vigorous myrmecologist will be able to pursue his interests more fully. The best wishes of all the members go to Doctor Creighton and to his wife, who has been his constant companion and helper. May they enjoy many happy and profitable years.

The new Editor, as of this issue, is Doctor Lucy W. Clausen. She has been an active worker and a guiding force in the Society for many years. The members have evidenced their esteem and confidence in Doctor Clausen over the years by electing her to the offices of Secretary, Vice-president, and President. At various times she has served on practically all committees, often for more than just one term, and many times as chairman.

Her experiences in the field of entomology have been wide and

varied. She was associated with the American Museum of Natural History both in the Department of Insects and Spiders, in which she is still an Associate, and in the Department of Education. She is the author of INSECT FACT AND FOLKLORE, a book published by the Macmillan Company. Presently, she is Assistant Professor of Microbiology at the Columbia University College of Pharmacy. The Society is indeed happy that she has accepted the important task of editing the JOURNAL.

James Forbes

UNDESCRIBED SPECIES OF CRANE-FLIES FROM THE HIMALAYA MOUNTAINS (TIPULIDAE, DIPTERA), VI*

By CHARLES P. ALEXANDER
AMHERST, MASSACHUSETTS

The preceding part under this general title was published in the *Journal of the New York Entomological Society,* **68**: 135–144. At this time I am considering species of the Eriopterine genus *Gonomyia,* virtually all of which were taken by Dr. Fernand Schmid in Kumaon, Uttar Pradesh, India in 1958, in Madras, South India, in December 1958, and in Sikkim in 1959. Dr. Schmid's collections in the Himalayas over the past several years have quite revolutionized our knowledge of the crane-flies of this prolific region. One further species from South India was taken by the veteran collector of entomological specimens, Mr. P. Susai Nathan. I am very deeply indebted to Messrs. Schmid and Susai Nathan for their continued interest in saving these fragile and often neglected flies. The types of the species are preserved in my personal collection.

Gonomyia (Protogonomyia) aitholodes new species

Size small (wing of female about 4.5 mm.); general coloration dull brownish black; antennae, halteres and legs black; wings tinged with blackish, the prearcular and costal fields slightly more yellowed; veins R_3 and R_4 divergent, narrowing cell R_1 at the margin, cell *2nd* M_2 unusually deep; ovipositor with the cerci narrowly produced at tips.

FEMALE Length about 4.5 mm.; wing 4.6 mm.; antennae about 1.5 mm.

Rostrum and palpi black. Antennae relatively long, if bent backward extending about to the root of the halteres, black throughout; flagellar segments long, subequal to or a trifle shorter than the longest verticils; besides the verticils, the segments bear several setae of moderate length scattered over the surface. Head dark brown.

Pronotum dark brown, scutellum and anterior pretergites obscure yellow. Mesonotum dull brownish black, scutellum a trifle paler; posterior parts of scutal lobes obscure yellow. Pleura dull black, the dorsopleural region, ventral pteropleurite and metapleura more obscure brownish yellow. Halteres and legs black. Wings with a strong blackish suffusion, the prearcular and costal regions a trifle more yellowed; veins brown, paler brown in the bright-

* Contribution from the Entomological Laboratory, University of Massachusetts.

ened parts. Veins excepting those near the wing base with long macrotrichia, lacking on prearcular veins, basal fourth of *M*, more than the basal half of the first section of Cu_1 and the bases of the Anal veins, more extensively so on *2nd A*. Venation: *Sc* long, Sc_1 ending about opposite three-fourths to four-fifths *Rs*, Sc_2 shortly beyond the origin of the latter; veins R_3 and R_4 strongly divergent, narrowing cell R_1, this being only about one-fourth or one-fifth as extensive at margin as cell R_3; cell *2nd* M_2 nearly three times its petiole; *m-cu* before the fork of *M*.

Abdomen brownish black, in the type female filled with large elongated black eggs that are nearly as long as a single abdominal segment. Ovipositor about intermediate in structure between the conditions found in the subgenera *Protogonomyia* and *Ellipteroides*; cerci enlarged at base, densely covered with microscopic setulae, with a few setae, the outer end narrow, only the restricted apical part glabrous, tip obtuse; a major lobe ventrad of the cerci; hypovalvae very short and blunt, their tips obtuse; genital segment with the broader outer ring with scattered setae, the narrow basal ring glabrous.

HOLOTYPE, ♀, Lingari, Pauri Garhwal, Kumaon, 4400 feet, September 1, 1958 (Schmid).

Gonomyia (*Protogonomyia*) *aitholodes* is quite distinct from *G.* (*P.*) *nigripes* (Brunetti) and allied forms in the venation and structure of the ovipositor. The venation of the outer radial field, as the short vein R_3 is more as in various species that have been referred to the subgenus *Ellipteroides* Becker, such as *G.* (*E.*) *ebenomyia* Alexander and *G.* (*E.*) *schmidi* Alexander.

Gonomyia (Euptilostena) moghalica new species

Size medium (wing of male to 6 mm.); general coloration of head and mesonotum gray, pleura striped with whitish; antennal flagellum dark brown to black; wings strongly yellowed, restrictedly patterned with brown; male hypopygium with three dististyles, the inner one small and slender; aedeagus before apex with two small recurved points.

MALE Length about 4.5–5 mm.; wing 4.8–6 mm.

FEMALE Length about 6 mm.; wing 5.5 mm.

Rostrum brownish black; palpi black. Antennae with scape yellow, slightly darker beneath, pedicel light yellow, basal flagellar segments dark brown, the outer ones passing into black; flagellar segments oval to long-oval, subequal to or shorter than the longest verticils. Head light yellow in front and on the anterior orbits, posterior part gray.

Pronotal scutum brownish gray, broadly yellow laterally, scutellum obscure yellow; pretergites narrowly yellow, variegated at midlength with dusky. Mesonotal praescutum and scutum dark gray, the former with vaguely indicated darker gray intermediate stripes, the humeri restrictedly brightened; pseudosutural foveae brownish black; scutellum brownish gray, obscure brownish yellow posteriorly; mediotergite brownish gray, the antero-

lateral part restrictedly yellowed, pleurotergite obscure yellow above, more brownish gray ventrally. Pleura dark gray, with a broad whitened longitudinal stripe extending from the fore coxae to the base of abdomen, widened behind; dorsopleural membrane dusky. Halteres with stem pale brown yellowed at base, knob darker. Legs with fore and middle coxae chiefly whitened, the posterior pair more testaceous yellow, darker basally; trochanters brownish yellow; remainder of legs brownish yellow, the tarsi passing into black. Wings strongly yellowed, prearcular and costal fields clearer yellow; stigma oval, dark brown; more restricted brown seams at origin of *Rs*, cord, *m–cu*, tip of R_3 and the supernumerary crossvein, and the fork of M_{1+2}; veins brownish yellow, dark brown in the patterned areas. Macrotrichia on longitudinal veins beyond the level of origin of *Rs*, including both Anals, lacking on the stem of *Sc*. Venation: *Sc* short, Sc_1 ending just beyond origin of *Rs*, Sc_2 far retracted; R_{1+2} and R_3 contiguous at margin, barely or virtually closing cell R_1; supernumerary crossvein in cell R_3 subequal to R_{1+2}, in cases somewhat shorter; petiole of cell *2nd* M_2 a little shorter than the cell; *m–cu* not quite twice its length before the fork of *M*.

Abdominal tergites dark brown, the posterior borders narrowly but conspicuously light yellow; sternites brown, darker brown laterally, subterminal segments more uniformly darkened; hypopygium yellowish brown to reddish brown; in female the posterior borders of the sternites are more evidently yellowed. Male hypopygium with the outer lobe of the basistyle moderately large, somewhat pointed at tip, with few setae; inner apical lobe short and broad, dusky in color. Three dististyles, the outer branched style glabrous, its lateral arm short, axial branch long and straight; second style broad at base, the apical third narrowed and blackened, margin scabrous, tip blunt, with two or three strong bristles; inner style small, the basal half dilated, outer part very slender, with a few setae. Aedeagus relatively slender, apex blunt, before tip with two small recurved points.

HOLOTYPE, ♂, Chhana, Almora, Kumaon, 3500 feet, September 22, 1958 (Schmid). Allotopotype, ♀, pinned with type. Paratopotypes, 5 ♂ ♀

Gonomyia (Euptilostena) moghalica is most similar to the central European *G.* (*E.*) *jucunda* Loew and the Javanese *G.* (*E.*) *supernumeraria* Alexander, differing in the details of venation and coloration. The regional *G.* (*E.*) *reticulata* Alexander is more distinct in its wing pattern and in the structure of the male hypopygium, particularly the striking four-spined aedeagus.

Gonomyia (Idiocera) involuta new species

Size relatively large (wing of male 7.5 mm.); mesonotum brown, the praescutum with a central darkening; pleura pale brown with a broad pale yellow longitudinal stripe; legs light brown; wings faintly tinged with

brown, prearcular and costal fields more yellowed; stigmal darkening small; *Sc* long, veins R_{1+2} and R_3 nearly contiguous at margin, cell R_3 large; male hypopygium with apical lobe of basistyle short; three dististyles, the inner and outer ones short, bispinous, blackened, intermediate style longer, including an outer flattened blade and a short black inner basal spine.

MALE Length about 7 mm.; wing 7.5 mm.

Rostrum brown; palpi brownish black. Antennae with scape yellowed, pedicel brown, paler basally, flagellum black; flagellar segments elongate, subcylindrical, exceeding the verticils, clothed with a delicate erect pale pubescence. Head (on slide) obscure yellow.

Pronotum yellowed. Mesonotal praescutum yellowish brown, with a darker central stripe that is narrowly bordered by darker brown, the area wider on posterior half; scutum light brown, scutellum darker; mediotergite brown, the anterolateral parts, together with most of the pleurotergite, light yellow. Pleura pale brown, with a broad pale yellow longitudinal stripe extending from the fore coxae to the abdomen. Halteres pale (apex of knob destroyed by insect pests). Legs with coxae yellow, trochanters slightly darker yellow; remainder of legs light brown, outer tarsal segments somewhat darker. Wings long, including the prearcular field; faintly tinged with brown, prearcular and costal fields yellow; stigma very small, pale brown; veins light brown, the cord darker. Macrotrichia on most longitudinal veins of outer two-thirds of wing, lacking on R_3; basad of this with a series on more than the outer third of vein *2nd A;* costal fringe of male relatively long and conspicuous. Venation: *Sc* long, Sc_1 ending beyond one-third the length of the long *Rs*, Sc_2 just before origin of the latter; veins R_{1+2} and R_3 nearly contiguous at margin, virtually closing cell R_1; cell *2nd* M_2 deep, more than twice its petiole.

Abdominal tergites brown, sternites somewhat paler; hypopygium with the basistyles obscure yellow. Male hypopygium with the apical lobe of basistyle short and stout, the inner face with long setae, the outermost yellow, the more proximal ones infuscated. Three dististyles; outer style blackened, relatively short, produced into two acute spines, with other smaller points; intermediate style very unequally bifid, including a long flattened glabrous outer arm, its tip obtuse, and a short powerful blackened basal spine; inner style subequal in size to the outer one, heavily blackened, terminating in two curved spines, the inner margin with strong setae. Aedeagus elongate, slightly expanded outwardly, the apex slender, gently curved.

HOLOTYPE, ♂, Yagtang, Sikkim, 11,650 feet, in *Rhododendron* area, June 17, 1959 (Schmid).

The most similar regional species is *Gonomyia* (*Idiocera*) *myriacantha* Alexander, of the western Himalayas, which differs conspicuously in the structure of the male hypopygium.

Gonomyia (Idiocera) maharaja new species

General coloration gray, praescutum with two brownish gray intermediate

stripes; antennae with proximal three segments yellow, the remainder darkened; legs obscure yellow, outer tarsal segments black; wings weakly tinged with yellow, restrictedly patterned with brown; veins R_{1+2} and R_3 narrowly separated at margin; male hypopygium large and conspicuous; basistyle with apical lobe elongate; three dististyles, all more or less bifid.

MALE Length about 5.5 mm.; wing 5.9 mm.

Rostrum and palpi black. Antennae with the proximal three segments yellow, succeeding segments passing through brown to brownish black; flagellar segments long-oval, subequal to the verticils. Head yellowish gray, the center of the posterior vertex slightly darker.

Pronotal scutum brownish gray, lateral margins yellow, scutellum and pretergites yellow. Mesonotal praescutum gray with two brownish gray intermediate stripes that are wider than the central interspace, lateral stripes much less distinct; posterior sclerites of notum brownish gray, scutal lobes with a brown spot, scutellum with a vague darkened central line. Pleura and pleurotergite light brown with a broad pale yellow longitudinal stripe extending from the fore coxa to the base of abdomen, dorsopleural membrane yellow. Halteres with stem yellow, knob weakly darkened. Legs with coxae yellow, the middle and posterior pairs weakly darkened basally; trochanters yellow; remainder of legs obscure yellow, outer tarsal segments black. Wings weakly tinged with yellow, the prearcular and costal fields more strongly so; stigma oval, dark brown; an extensive paler brown cloud at outer end of cells R_3 and R_4; very narrow darkenings that are virtually restricted to the veins at origin of *Rs*, cord, *m–cu* and outer fork of *M;* remaining veins beyond cord brownish yellow, basad of cord brighter yellow. Veins beyond level of origin of *Rs* with abundant macrotrichia; *2nd A* with a few trichia at outer end. Venation: Sc_1 ending about opposite one-third the length of the long *Rs*, Sc_2 before origin of *Rs;* veins R_{1+2} and R_3 only narrowly separated at margin; cell *2nd* M_2 about one-half longer than its petiole; *m–cu* about twice its length before the fork of *M*.

Abdomen dark brown, the posterior borders of the tergites paler, hypopygium brownish yellow. Male hypopygium large and unusually complex in structure, especially the dististyles. Basistyle with the outer apical lobe elongate, obtuse at tip, with numerous long setae, more abundant at and near apex. Three dististyles, the largest and most complex one stout at base, bifid into two long slender glabrous arms, the outer one with a small appressed spine on margin near base; intermediate style a little shorter, very unequally bifid at near midlength, the long slender outer arm glabrous, narrowed gradually to the subacute tip, the inner arm short and stout, its outer angle farther produced into an acute point; inner style profoundly bifid from a very short common base, the outer arm more slender, the stouter lower arm with several strong setae, terminating in a blackened spine. Aedeagus elongate, the lower margin near apex produced into a low lobe or tubercle.

HOLOTYPE, ♂, Lata, Pauri Garhwal, Kumaon, 7500 feet, July 6, 1958 (Schmid).

Gonomyia (*Idiocera*) *maharaja* is readily told from other regional species having unusually complex male hypopygia by the structure of this organ, particularly the dististyles. The most similar of such species include *G.* (*I.*) *accincta* Alexander and *G.* (*I*). *myriacantha* Alexander.

Gonomyia (Lipophleps) curvistyla new species

Size very small (wing of male 3 mm.); general coloration of mesonotum brownish gray, scutellum yellowed; pleura dark brown with a broad whitened longitudinal stripe; femora obscure yellow with a brownish black nearly terminal ring, posterior pair with a series of long erect bristles; wings variegated with pale brown and subhyaline, the prearcular and costal fields light yellow; male hypopygium with three dististyles, the intermediate one a very long curved rod; phallosome consisting of a pair of strong rods, their outer ends blackened, produced laterad into a spine.

Male Length about 3 mm.; wing 3 mm.

Rostrum brown, mouthparts more brightened, palpi black. Antennae with basal segments orange yellow, the scape and pedicel patterned with brown; basal flagellar segments brownish yellow, with the usual very long verticils; outer segments dark brown, terminal three segments oval, relatively short. Head orange yellow, central part of the posterior vertex restrictedly darkened.

Pronotum and pretergites very pale yellow, darkened laterally. Mesonotal praescutum brownish gray, pseudosutural foveae castaneous; scutal lobes dark gray, posterior angles and midregion yellowed; scutellum yellow, brownish gray at base; mediotergite brownish gray, the anterolateral parts broadly obscure yellow; pleurotergite obscure yellow. Pleura chiefly dark brown, with a broad whitened longitudnal stripe extending from the fore coxa to the base of abdomen, the dorsal pleurites paler brownish yellow. Halteres light yellow, the lower part of knob chiefly brown. Legs with the fore coxae extensively whitened, remaining coxae yellow, their bases restrictedly darkened; trochanters yellow; femora obscure yellow, with a conspicuous brownish black nearly terminal ring; tibiae and basitarsi testaceous yellow, tips narrowly blackened, remainder of tarsi black; posterior femora with a row of long erect setae along the entire lower margin, the bristles about 25 to 30 in number, the longest about twice the diameter of the femur at point of insertion. Wings variegated with extensive pale brown and subhyaline areas, producing a variegated effect; prearcular and costal fields light yellow; veins very pale brown, still paler in the brightened fields. Vein R_5, all outer Medial veins and distal section of Cu_1 with macrotrichia, with very few at extreme ends of both Anals, more numerous on *2nd A*, lacking on *Rs*, *M* and basal section of Cu_1; costal fringe of male long and conspicuous. Venation: *Sc* short, Sc_1 ending some distance before origin of *Rs*; basal section of *Rs* long; *m–cu* close to fork of *M*.

Abdominal tergites dark brown, the incisures narrowly paler, sternites pale; hypopygium brownish yellow. Male hypopygium distinctive; basistyle

short and compact. Three dististyles, the intermediate one a very long rod, strongly curved to the acute tip; outer style about three-fourths as long, simple, on outer two-thirds with a low flange, widest basally; inner style elongate, pointed at outer end, the two fasciculate bristles unusually reduced, shorter and more slender than several of the normal setae. Phallosome consisting of a pair of strong rods slightly expanded and blackened at outer end, produced laterad into a sharp spine, and a pair of small flattened blades that terminate in obtuse lobes.

HOLOTYPE, ♂, Teri, Teri Garhwal, Kumaon, 2500–5000 feet, April 16, 1958 (Schmid).

This unusually small member of the genus is quite distinct from all described regional species in the structure of the male hypopygium, particularly the dististyles. The greatly lengthened intermediate style is likewise found in certain New World members of the subgenus. In the present fly these structures are similar on the two sides, not asymmetrical as in some species.

Gonomyia (Lipophleps) dissimilis new species

General coloration of mesonotum brownish gray, scutellum broadly light yellow; pleura darkened, with a very conspicuous whitened longitudinal stripe; femora yellow with a broad black subterminal ring, posterior pair in male with a series of long erect bristles; wings marbled with light gray and whitish subhyaline, stigma darker; abdominal tergites dark, the posterior borders broadly yellow; male hypopygium with two dististyles, the outer very unequally bifid; phallosome with gonapophyses long and conspicuous, black, dissimilar in form.

MALE Length about 3.5 mm.; wing 3.8 mm.

FEMALE Length about 5 mm.; wing 5 mm.

Rostrum and palpi black. Antennae of male black, of female the basal segments restrictedly patterned with yellow; flagellar segments elongate, in the male with very long verticils. Head yellowed above, with a central darkening on vertex, lower surface infuscated.

Pronotum light yellow above, brown laterally, pretergites light yellow. Mesonotal praescutum and scutum brownish gray, with indications of a darker pattern, including four vague praescutal stripes; scutellum behind broadly light yellow, base dark gray; mediotergite light gray, darker behind, the anterior sides, with adjoining parts of the pleurotergite, yellowed, remainder of the latter brown, pruinose. Pleura blackened, sparsely pruinose, brown above; a very conspicuous white longitudinal line extending from and including the fore coxa, reaching the abdomen behind. Halteres with stem clear yellow, knob dark brown, the tip yellowed. Legs with fore coxae whitened, remaining coxae darkened basally, tips yellow; trochanters yellow; femora yellow, with a broad brownish black subterminal ring, the actual tip narrowly whitened; tibiae and tarsi yellow, the outer tarsal segments infuscated; posterior femur of male with a series of nearly 30 long

bristles distributed over the whole length of ventral surface, more or less evenly spaced. Wings marbled light gray and whitish subhyaline, the latter areas large, occurring in most cells, before cord forming two nearly complete crossbands; stigma oval, darker brown; very slight darkenings at tip of *Sc* and at arculus; prearcular and costal regions light yellow, including areas before and beyond stigma; veins light brown, cord darker, veins *C* and *Sc* paler. Macrotrichia on longitudinal veins beyond cord, including also the tips of *Sc* and the Anals. Venation: *Sc* short, the distance on costa between Sc_1 and origin of *Rs* more than one-half the length of the latter; branches of *Rs* divergent; basal section of R_5 distinct; *r–m* long, arcuated; *m-cu* at or some distance before the fork of *M*.

Abdomen brownish black, posterior borders of tergites broadly yellow; hypopygium dark. Ovipositor with hypovalvae and bases of cerci brownish black. Male hypopygium with the basistyle relatively small, the mesal apical face densely setuliferous. Two terminal dististyles, the outer very unequally bifid, including a long slender smooth outer arm, gradually narrowed to the obtuse tip, inner arm a small blackened structure, extended into a strong spine, with a smaller more basal tooth; inner style small, strongly narrowed on outer fourth, tipped with the usual pair of long yellow bristles, some of the normal setae virtually as long. Phallosome including two powerful blackened gonapophyses, dissimilar in form, one gradually narrowed and gently curved to the acute tip, the other angularly bent at near two-thirds the length, the long outer spine stout, acute at tip.

HOLOTYPE, ♂, Perumalmalai, Madras, South India, 4000–4500 feet, December 6, 1958 (Schmid). Allotopotype, ♀, with the type. Paratypes, 2 ♀♀, Sathuparai, Madras, 1500 feet, December 1, 1958 (Schmid).

Gonomyia (*Lipophleps*) *dissimilis* is quite distinct from the numerous regional species of the subgenus in the structure of the male hypopygium. In the pattern of the legs and wings it suggests *G.* (*L.*) *lanka* Alexander and some others.

Gonomyia (Lipophleps) nilgiriana new species

Belongs to the *manca* group, allied to *hedys;* mesonotum brownish gray, posterior sclerites more yellowed; pleura light brown with a conspicuous whitened longitudinal stripe; wings weakly tinged with brown, patterned with clearer areas; *Sc* short; abdominal tergites dark brown, conspicuously patterned with yellow; male hypopygium with the outer dististyle bifid, its lateral arm scabrous; inner style with a slender outer lobe; phallosome asymmetrical, including a trispinous central structure.

MALE Length about 3.2 mm.; wing 3.5 mm.

Rostrum dark brown, palpi black. Antennae black, the dorsal surface of scape slightly paler; flagellar segments long, in the male with exceedingly long verticils. Head pale yellow, the center of the posterior vertex darkned.

Pronotum whitish yellow above, narrowly darker on sides, this continued

back to the wing root along the pretergites and extreme lateral border of praescutum and scutum; disk of praescutum and scutum almost uniformly brownish gray, clearer gray laterally; scutellum yellow, narrowly darkened medially at base; mediotergite obscure yellow, with nearly the posterior half more darkened; pleurotergite chiefly yellowed. Pleura light brown, with a broad whitened longitudinal stripe extending from the fore coxa to the base of abdomen. Halteres dusky, knob extensively yellowed. Legs with coxae testaceous yellow, the fore pair whitened; trochanters brownish yellow; remainder of legs broken. Wings weakly tinged with brown, stigma slightly darker brown; clearer areas before and beyond stigma and elsewhere on disk, especially just before and beyond the cord and in the cells of the posterior half of wing; prearcular and costal fields clearer yellow; veins very pale brown, the cord slightly darker. Macrotrichia on distal section of R_5 and on all outer branches of *M*, lacking on *Rs*, its anterior branch and the Anal veins. Venation: *Sc* short, Ss_1 ending a distance before origin of *Rs* about equal to two-thirds the length of the latter; branches of *Rs* divergent, cell R_3 very wide at margin; *m–cu* close to the fork of *M*.

Abdominal tergites dark brown, the posterior and lateral borders of the segments yellow, sternites paler; hypopygium brownish yellow. Male hypopygium with the outer dististyle an elongate blackened scabrous rod, on mesal margin at base with a long slender smooth spine; inner style short and compact, with about nine strong setae, outer margin produced into a slender lobe that is tipped with a short black spine, the total length of the lobe only about one-half that of the spine of the outer style. Phallosome consisting of paired elongate rods, membranous and hinged at about midlength, the outer part decurved, narrowed, at tip with a few microscopic scabrous points; central arm including a massive yellow structure that is produced into three powerful spines, the intermediate one more slender.

HOLOTYPE, ♂, Cherangode, Nilgiri Hills, South India, 3500 feet, September 1950 (Susai Nathan).

Gonomyia (*Lipophleps*) *nilgiriana* is most similar to *G.* (*L.*) *hedys* Alexander, differing conspicuously in the structure of the male hypopygium, particularly the dististyles and phallosome.

Gonomyia (Gonomyia) ishana new species

Size large (wing of male 6.5 mm.); mesonotal praescutum reddish brown with three darker brown stripes, scutellum obscure yellow; pleura reddish brown, striped longitudinally with light yellow; wings strongly tinged with yellowish brown, the prearcular and costal fields clear yellow; male hypopygium with the apical lobe of basistyle long and slender, with relatively few setae; outer dististyle slender, dilated at apex into a triangle, the angles produced into points; inner style with a strong basal spine; phallosome with the apophyses long and slender, acutely pointed and blackened at tips.

MALE Length about 6 mm.; wing 6.5 mm.

Head broken. Pronotum and pretergites clear light yellow. Mesonotal

praescutum reddish brown with three darker brown stripes that are scarcely darker than the ground, humeral and lateral regions broadly light yellow; pseudosutural foveae linear, castaneous; scutal lobes dark brown, median area broadly light yellow; scutellum obscure yellow, the base weakly darkened; mediotergite brown, the lateral parts and a transverse line on anterior half yellow; pleurotergite light yellow, more reddened ventrally. Pleura reddish brown, with a broad light yellow longitudinal stripe that is expanded posteriorly; dorsopleural region extensively yellow. Halteres with stem dirty white, knob infuscated. Legs with fore coxae light yellow, remaining coxae reddish yellow; trochanters brownish yellow; femora obscure yellow, tips slightly darkened; tibiae and tarsi light brown, the latter darker outwardly. Wings strongly tinged with yellowish brown, prearcular and costal fields clear yellow; stigma scarcely differentiated, pale brown; veins pale brown, yellowed in the brightened fields. Veins of outer three-fourths of wing with macrotrichia, including the outer two-thirds of *1st A*. Venation: Sc_1 ending about opposite one-third to one-fourth the length of *Rs*, Sc_2 slightly removed; basal section of *Rs* short; cell *1st* M_2 long, nearly rectangular, subequal to or slightly exceeding vein M_4; *m–cu* shortly beyond the fork of *M*.

Abdominal tergites dark brown on central parts, the margins broadly yellowed; sternites and hypopygium yellow. Male hypopygium with the apical lobe of basistyle long and slender, with relatively few setae at apex and again near base, the intermediate part more glabrous. Three dististyles or profound branchs, the longest very slender, expanded at apex and here produced into two points, one obtuse at tip, the other acute, the apical margin back from the latter spine with very long setae; intermediate style a small slender arm, its apical fourth narrowed into a long spine, with a strong seta at the base; inner style with a powerful basal arm that terminates in a blackened spine, with a small pale spine outwardly at its base; body of style stout, with two strong closely approximated fasciculate bristles, together with other normal smaller setae, the outer or dorsal part of body glabrous. Phallosome including two strong gonapophyses that terminate in long blackened spines, the longer very sinuous; aedeagus beyond the apophyses relatively small, pale, bilobed.

HOLOTYPE, ♂, Trijugi, Pauri Garhwal, Kumaon, 7000 feet, May 26, 1958 (Schmid).

The nearest regional allies include other large species such as *Gonomyia* (*Gonomyia*) *decacantha* Alexander and *G.* (*G.*) *ravana* Alexander, all being readily told among themselves by differences in structure of the male hypopygium.

THE NORTH AND CENTRAL AMERICAN SPECIES OF EURYPTERA AND A RELATED NEW GENUS (COLEOPTERA, CERAMBYCIDAE)

BY E. GORTON LINSLEY
UNIVERSITY OF CALIFORNIA, BERKELEY

Euryptera is one of several related genera of diurnal flower and foliage visiting Lepturini which include species exhibiting lycid-like coloration and form. This resemblance is expressed in yellow, orange, or reddish dorsal integumental colors, often contrasted with black elytral or thoracic markings or both. There is a tendency toward flattened and apically expanded elytra, in some cases with the development of costae, basally modified antennae, and other specializations associated with lycid-like appearance among Cerambycidae. These features, involving as they do convergence in coloration and form among different species, have made identification from descriptions alone difficult or uncertain. The following key, based upon study of the types of most of the named species, is presented in the hope that it will aid in the identification of the described species and thus indirectly stimulate ecological and behavioral studies which will help explain their lycid-like appearance and clarify their status in relation to the theory of mimicry.

KEY TO THE DESCRIBED NORTH AND CENTRAL AMERICAN SPECIES OF *Euryptera*

1 Elytra black or predominantly black 2
— Elytra yellowish to reddish, concolorous or with the suture in part or the apices black 7
2(1) Pronotum black or black with the sides fulvous 3
— Pronotum yellow or yellowish, also the head, thorax, scutellum, metasternum, and the anterior and middle femora; form moderately robust. 11.5 mm. Western Texas (Davis Mts.) .... *texana*
3(2) Elytra without well defined costae 4
— Elytra distinctly bicostate, the epipleura abruptly vertical. 9–11 mm. Mexico .... *costulata*
4(3) Pronotum gradually or feebly arcuately declivous to anterior margin; antennae with third to sixth segments unequal in length 5
— Pronotum elevated in front and steeply declivous to anterior mar-

gin; antennae with third to sixth segments unequal in length. 9 mm. Mexico (Chihuahua) .... *batesi*

5(4) Elytra with punctures moderately coarse and well separated, surface wholly black or rarely brownish; pronotum usually black, rarely fulvous at sides 6

— Elytra with punctures small and dense, humeral area usually fulvous; prontum nearly always broadly fulvous at sides. 9–11 mm. Southeastern United States to Central Mexico .... *lateralis*

6(5) Elytra dullish, asperate-punctate. 7–10 mm. Southern Arizona (Cochise Co.) and northern Mexico (Chihuahua) .... *chihuahuae*

— Elytra shining, not asperate-punctate. 6.5–10.5 mm. Southern Arizona (Chiricahua, Santa Catalina, Santa Rita, and Huachuca Mts.) .... *huachucae*

7(1) Elytra distinctly costate or longitudinally sulcate 8

— Elytra smooth, at most feebly or indistinctly costate or sulcate 9

8(7) Pronotum at base much narrower than elytra, black, evenly convex, shining and thinly pubescent; elytra elongate, reddish, delicate, finely costate. 14 mm. Mexico (Durango) .... *longipennis*

— Pronotum at base nearly as wide as elytra, densely pubescent, reddish with an elevated median black ridge; elytra with a flexuous longitudinal sulcus, uniformly reddish in the male, apical half black in the female. 11–15 mm. Mexico (Vera Cruz) to Panama .... *patricia*

9(7) Elytra moderately to strongly convex, less than three times as long as basal width 10

— Elytra elongate, flattened, more than three and one-half times as long as basal width, apices flaring slightly; median black line of pronotum continued along elytral suture where it becomes attenuated beyond middle, the surface otherwise golden orange. 11.5 mm. Panama .... *sericea*

10(9) Pronotum with median longitudinal black line 11

— Pronotum concolorous red or yellowish-brown 12

11(10) Median black line of pronotum wider than scutellum; posterior angles of pronotum acutely produced over humeri; elytral pubescence moderately long, suberect; elytra yellowish with apical half to one-third black in both sexes. 7.5–8 mm. Florida and Mexico (Hidalgo) .... *lateralis* var. *flavatra*

— Median black line of pronotum narrower than scutellum; posterior angles of pronotum not acutely produced over humeri; elytral pubescence moderately short, subdepressed; elytra concolorous yellowish in female, apical half black in male. 8–9 mm. Mexico (Vera Cruz, Hidalgo) .... *mimula*

12(10) Elytra concolorous red or yellowish-brown 13

— Elytra rufo-testaceous with apical one-fifth black; pronotum and elytra uniformly and regularly clothed with posteriorly directed recurved hairs; elytral apices obliquely truncate, outer angle dentiform; apical angles of abdomen spiniform. 10 mm. Panama (Canal Zone) .... *spinifera*

13(12) Head and ventral surface black; pronotum and elytra red 14

— Head red and yellowish-brown or brown; pronotum and elytra red or yellowish 15

14(13) Scutellum red; antennal tubercles, vertex and upper eye margins densely clothed with long appressed golden hairs; elytra without costae, not wider before apex, apices transversely sinuate-truncate, outer angle dentiform. 14 mm. Mexico (Morelos) .... *flammata*

— Scutellum black; antennal tubercles thinly clothed with erect black hairs; elytra feebly costate, flaring slightly before apex, apices rounded to outer angle which is not dentiform. 11 mm. Southern Arizona (Huachuca and Chiricahua Mts.) .... *cruenta*

15(13) Elytra shining, punctures finer than those of pronotum 16

— Elytra opaque, punctures larger than those of pronotum; reddish-brown, with eyes, antennae, apices of mandibles and femora, tibiae and tarsi, dark brown or black. 12.6 mm. Arizona (Santa Catalina Mts.) .... *sabinoensis*

16(15) Pronotum and elytra yellowish-brown 17

— Pronotum and elytra red; elytral apices broadly rounded from suture to external angle which is scarcely dentiform. 13 mm. Southern Arizona (Huachuca, Chiricahua and Pinaleno Mts.) .... *ignita*

17(16) Head short, distance between eye and base of mandible shorter than width of mandible at base 18

— Head elongate, distance between eye and base of mandible distinctly longer than width of mandible at base; elytral apices flexuose-truncate with a distinct tooth externally. 15 mm. Mexico (Guerrero) .... *unicolor*

18(17) Elytra with punctures very dense, giving a crenulate appearance to the surface. 11–12 mm. Western Texas (Davis Mts.) *texana* var.

— Elytra with punctures well separated. 12.5–14 mm. Southern Arizona (Huachuca and Santa Rita Mts.) .... *breviceps*

Euryptera texana Knull

Euryptera texana Knull, 1941, Ohio Jour. Sci., **41**: 388.
Euryptera texanae Knull, 1954, Ohio Jour. Sci., **54**: 129.

This species was described from a female from the Davis Mountains, Texas, July 3, 1940 (D. J. and J. N. Knull). The type specimen is black, with the head, thorax, scutellum, mesosternum and anterior and middle femora yellowish. The pronotum and elytra are both finely, densely punctate but the punctures of the latter are larger. However, Professor Knull informs me that he has since captured an entirely yellowish-brown example in the Davis Mountains and I have seen a similar specimen from Alpine, Texas.

Euryptera costulata Bates

Euryptera costulata Bates, 1885, Biologia Centrali-Americana, Coleoptera, **5**: 284.

This species is suggestive of *E. lateralis* (Olivier) but the elytra are distinctly bicostate, the epipleura abruptly vertical, and the apices separately rounded. It is known from Oaxaca, Jalapa, Juquila, and Cerro de Plumas, Mexico.

Euryptera batesi Linsley, new name

Euryptera chihuahuae ♂ (?), Bates, 1885, Biologia Centrali-Americana, Coleoptera, **5**: 285.

The male described by Bates represents a species distinct from *E. chihuahaue*. It resembles *E. lateralis* (Olivier) superficially, but in the same sex the two differ in the form of the antennae, which in *batesi* are more slender with the third to sixth segments subequal in length, and the form of the pronotum, which in *batesi* is abruptly elevated and convex in front. The type, from Pinos Altos, Chihuahua (Buchan-Hepburn) is in the British Museum (Natural History).

Euryptera lateralis (Olivier)

Leptura lateralis Olivier, 1795, Entomologie, **4** (73): 22, pl. 3, fig. 37.

Euryptera lateralis Leng, 1890, Entom. Americana, **6**: 213; Bates, 1885, Biologia Centrali-Americana, Coleoptera, **5**: 284; Hopping, 1937, Nat. Mus. Canada, Bull. **85**: 27.

Leptura distans Germar, 1824, Ins. Spec. Nov., p. 524.

Leptura cincta Haldeman, 1847, Trans. Amer. Philos. Soc., (2) **10**: 63.

Leptura obsoleta Haldeman, 1847, Trans. Amer. Philos. Soc., (2) **10**: 63.

Euryptera subintegra Casey, 1924, Memoirs on the Coleoptera, **11**: 285.

This species has been taken most abundantly in southeastern United States and material at hand is from North Carolina, Alabama, and Mississippi. Mexican material has been seen from Vera Cruz [San Rafael, Jicaltepec (F. C. Bowditch)] and Tamaulipas [2 mi. N. of El Simon, and Villagran (P. D. Hurd)]. Bates (1885) has also recorded the species from Oaxaca and Playa Vicente.

Euryptera lateralis var. *flavatra* Blatchley

Euryptera flavatra Blatchley, 1914, Canadian Ent., **46**: 92.

Euryptera lateralis flavatra Knull, 1954, Ohio Jour. Sci., **45** : 129.

E. flavatra Blatchley was synonymized with *E. lateralis* by Hopping (1937), treated as a subspecies of *lateralis* by Knull (1954). I have seen material from Jacksonville, Tarpon Springs, Leesburg, Gainesville and Enterprise, Florida, mostly taken during March, and from Jacala, Hidalgo, Mexico, 4500 ft. elevation, July 5, 1939 (R. Haag, Museum of Comparative Zoology). The type is from Dunedin, Florida.

Euryptera chihuahuae Bates

Euryptera chihuahuae Bates, 1885, Biologia Centrali-Americana, Coleoptera, **5**: 285.

The type of this species is a male, not a female, as supposed by Bates. A female from Arroyo Mesteno, Sierra del Nido, elevation 7,600 feet, July 11, 1959 (W. C. Russell) has shorter and heavier antennae.

Euryptera huachucae Schaeffer

Euryptera huachucae Schaeffer, 1905, Mus. Brooklyn Inst. Arts Sci.; Sci. Bull., **1**: 134; Hopping, 1937, Nat. Mus. Canada, Bull. **85**: 284; Knull, 1954, Ohio Jour. Sci., **54**: 129.

E. huachucae is very close to *E. chihuahuae,* and in the absence of a series of topotypical material of the latter, the status of the two names is difficult to determine. What I take to be both forms are represented in material from Cochise County, Arizona (California Academy of Sciences).

Euryptera longipennis Bates

Euryptera longipennis Bates, 1885, Biologia Centrali-Americana, Coleoptera **5**: 286.

I have seen only the type of this distinctive species, from Ciudad Durango, elevation 8100 feet.

Euryptera patricia Bates

Euryptera patricia Bates, 1885, Biologia Centrali-Americana, Coleoptera, **5**: 286, pl. 20, fig. 14.

Euryptera princeps Bates, 1885, Biologia Centrali-Americana, Coleoptera, **5**: 286, pl. 20, fig. 11 (New Synonymy)

The type of *E. patricia* from Cordova, Mexico (Sallé), is a female, that of *E. princeps* from Volcan de Chiriqui, Panama, a male. Aside from differences in coloration, a common sex feature in *Euryptera,* the other differences are apparently sexual also, the male being more elongate with the pronotum and base of elytra narrower. A female from Chiriqui, Panama, in the Naturhistoriska Riksmuseet, Stockholm, appears to be typical of *E. patricia,* thus eliminating geographical reasons for regarding the two as representing separate species. *E. patricia* is distinctly lyciform.

Euryptera sericea Bates

Euryptera sericea Bates, 1885, Biologia Centrali-Americana, Coleoptera, **5**: 285.

The type, if a male, has unusually heavy antennae for that sex, contributing to its lycid-like appearance. It is from Volcan de Chiriqui, Panama, elevation 4,000-6,000 feet.

Euryptera mimula Bates

Euryptera mimula Bates, 1885, Biologica Centrali-Americana, Coleoptera, **5**: 285.

E. mimula Bates is the same size and form and expresses the same dichromatism in the two sexes as *Ophistomis xanto* Bates.

Euryptera spinifera Linsley, new species

Female Form moderately robust; integument shining, yellow, pronotum and elytra rufo-testaceous, the latter with apices black, eyes, antennae except base of scape, apex of clypeus, labrum, mandibles at middle, apices of femora, anterior tibiae at apex, intermediate and posterior tibiae and apices of second and third segments of intermediate and posterior tarsi black.

Head Clothed with short, erect, golden hairs, frons finely punctate, the punctures separated by several diameters, erect hairs longer at sides below antennal insertions, clypeus more coarsely punctate, the punctures separated by a diameter or less, vertex subcontiguously punctate; antennae reaching beyond middle of elytra, first four segments subcylindrical, finely punctate, clothed with suberect golden or brownish hairs (depending upon angle of light), with longer, coarser hairs at apex, segments five to eleven flattened but not serrate, more finely, densely punctate, more finely, densely clothed with shorter golden pubescence, with successively fewer long, coarse hairs at apex of segments five to seven than at apex of third and fourth segments, scape more than one-third longer than third segment, third segment barely longer than fourth but distinctly shorter than fifth, segments five to ten gradually decreasing in length. Pronotum. One and one-fifth times as

wide at base as long, apex nearly half as broad as width at middle, a little more than one-third as broad at base, posterior angles produced, surface moderately finely, closely punctate, each puncture bearing a posteriorly directed, recurved, coarse golden hair, the hairs well separated and not obscuring the surface; scutellum similarly clothed but more finely punctate; prosternum subglabrous; metasternum, abdomen, and femora punctate much like the dorsal surface and similarly clothed; apical angles of abdomen spiniform. ELYTRA. A little more coarsely punctate than pronotum and uniformly clothed with somewhat longer hairs which become black over the black apices which cover a little less than one-fifth of the total length; apices obliquely and feebly sinuately truncate; outer angle prominently and acutely dentiform. Length 10 mm.

HOLOTYPE female (Museum of Comparative Zoology, Harvard University) from Barro Colorado Island, Panama Canal Zone, July 14, 1924 (N. Banks).

This species is somewhat suggestive of *E. mimula* Bates, but differs in the more robust form, the more strongly produced lateral angles of the pronotum, and the much more similar pronotal and elytral punctation and pubescence. From *E. patricia* Bates, which also has the posterior pronotal angles produced, it differs in the more evenly convex elytra without longitudinal sulci and the less fine punctation and less dense pubescence of the dorsal surface. From both species it differs in details of coloration, most notably in the absence of a median longitudinal black line on the pronotum, and also in the spinose abdominal apex.

Euryptera flammata Linsley, new species

FEMALE Form robust; integument black, pronotum and elytra red. HEAD. Elongate, distance between eye and base of mandibles about twice as long as basal width of mandibles; antennal tubercles and sides of face below them finely, densely punctate, clothed with appressed golden pubescence which becomes longer on vertex and on upper eye margins, triangular area at base of clypeus almost impunctate, punctures becoming large and subcontiguous toward apex, labrum also coarsely punctate; antennae with segments one to four shining, moderately finely punctate, clothed with suberect, coarse black hairs, segments five to eleven dullish, minutely punctate, more finely, densely pubescent. PRONOTUM. Campanulate, sides feebly narrowed behind middle, basal angles acute, prolonged, disk moderately coarsely, subcontiguously punctate except for a short longitudinal ridge behind middle; scutellum finely, densely punctate, thinly pubescent; prosternum finely punctate and pubescent at middle; metasternum and abdomen more coarsely punctate, thinly pubescent. ELYTRA. More finely and less densely punctate than pronotum, clothed with moderately long, suberect reddish hairs which are shorter at base, apices sinuate-truncate, outer angle dentiform. Legs densely punctate. Length approximately 14 mm.

HOLOTYPE female (Coleccion Entomologica, Oficina de Estudios Especiales, S.A.G., Mexico City) from Cuernevaca, Morelos, Mexico, July 8, 1957, "sobre arbol-mango" (Wm. W. Gibson).

This species resembles *E. ignita* Schaeffer in size, form, and general coloration, differing in having the head and ventral surface black, the vertex, and the upper eye margins densely clothed with long appressed golden pubescence and the elytral apices sinuate-truncate with the outer angle dentiform.

Euryptera cruenta Martin

Euryptera cruenta Martin, 1930, Pan-Pacific Ent., **7**: 70, ♀ (?).
Euryptera cruneta Knull, 1954, Ohio Jour. Sci., **54** : 129.

In the type of this species, a female from the Huachuca Mts., Arizona, the head and its appendages are black, except the apex of the clypeus and the mouth-parts which are largely testaceous. The pronotum and elytra are dull sanguineous, the scutellum and ventral surface black.

Euryptera sabinoensis Knull

Euryptera sabinoensis Knull, 1954, Ohio Jour. Sci., **54**: 129.

This species is described in the female as reddish brown throughout, with the elytra opaque, and the tips of the mandibles, eyes, antennae, tips of femora, tibiae and tarsi dark brown to black. The type specimen was captured in Sabino Canyon, Santa Catalina Mountains, Arizona.

Euryptera ignita (Schaeffer)

Leptura ignita Schaeffer, 1908, Mus. Brooklyn Inst. Arts Sci., Sci. Bull., **1**: 341.
Cyphonotida ? ignita Leng, 1920, Catal. Coleoptera Amer. No. of Mexico, p. 273.
Euryptera ignita Hopping, 1937, Nat. Mus. Canada, Bull. **85**: 27; Knull, 1954, Ohio Jour. Sci., **54**: 129.

Euryptera ignita is a bright red species with the antennae black and the apex of the femora and tibiae, tarsi, and ventral surface brownish or piceous. It differs from *sabinoensis* in the shining elytra which are much more finely punctate than the pronotum.

Euryptera unicolor Bates

Euryptera unicolor Bates, 1892, Trans. Ent. Soc. London, **1892**: 159, pl. 6, fig. 3.

The type specimen, from Tepetlapa, Guerrero, elevation 3000 ft., is apparently a male. In coloration it is an eurypteran counterpart of *Ophistomis pallida* Bates.

Euryptera breviceps Linsley, new species

MALE Form moderately robust; integument shining, yellowish, head and pronotum slightly rufo-testaceous, antennae black, apices of femora (narrowly) and tibiae (more broadly) and tarsi piceous. HEAD. With upper frons and vertex dullish, finely, densely punctate, clypeus shining, more coarsely punctate; antennae with first four segments cylindrical, shining, moderately finely punctate, thinly clothed with moderately short, coarse, suberect hairs, segments three to ten flattened, dull, very finely, densely punctate and minutely pubescent, eleventh segment about one and one-half times as long as tenth, appendiculate. PRONOTUM. Campanuliform, sides slightly emarginate behind middle, posterior angles subacute, not prolonged, disk moderately, coarsely, closely punctate except for a narrow polished line at middle, pubsecence moderately short, subappressed, golden; scutellum finely punctate, thinly pubescent; prosternum polished, finely, sparsely punctate, meso- and metasternum finely, densely punctate, coxae of pro-, meso- and metasterna densely punctate, legs densely punctate. ELYTRA. Much more finely punctate than pronotum, rather densely clothed with suberect golden hairs which do not obscure the surface, apices broadly rounded to the external angle which is scarcely dentate. Length, approximately 13 mm.

HOLOTYPE male (California Academy of Sciences) from the Huachuca Mts., Arizona, July 17 (G. Beyer).

Although *E. breviceps* occurs in the same area as *E. ignita* (Schaeffer) and has been regarded as a color variant of that species, the structure of the head is so different, being very much shorter, with the distance between the lower margin of the eye and the base of the mandible less than the basal width of the mandible, that it seems unlikely that they can be forms of the same species.

MIMIPTERA Linsley, new genus

Form elongate, depressed, elytra expanded apically. Head moderately elongate; eyes convex, strongly emarginate at middle; antennae reaching to about middle of elytra, third and fourth segments each shorter than fifth, clothed with moderately long, suberect hairs, fifth to tenth segments subequal in length, expanded and minutely pubescent, eleventh segment more cylindrical. Pronotum campanuliform, lobed at base, longitudinally impressed on midline; prosternum with anterior coxae small, not exerted above level of intercoxal process, cavities acutely angulate externally; intermediate coxal cavities open to epimera. Elytra flattened, expanded beyond middle, densely fringed with hair, surface with obtuse longitudinal carinae and longitudinal sulcae, most evident apically; apices broadly truncate, both the sutural and external angles spinose. Abdomen with a stout spine on each side at lateral apical margin.

Type of genus: *Euryptera fulvella* Bates.

This genus differs at once from *Euryptera* in the small anterior coxae, which are not exerted and do not project above the intercoxal process.

Mimiptera fulvella (Bates)

Euryptera fulvella Bates, 1885, Biologia Centrali-Americana, Coleoptera, **5**: 286, pl. 20, fig. 12.

Euryptera planicoxis Bates, 1892, Trans. Ent. Soc. London, 1892:159, pl. 2, fig. 5. (New Synonymy).

FIG. 1. *Mimiptera costaricensis* (Melzer).

The two types are from Panama (San Feliz and Chiriqui) and essentially identical. This species is fulvochraceous with the antennae, the mid-line of the pronotum, and sometimes the legs more or less blackish. It resembles a small pale lycid.

Mimiptera costaricensis (Melzer)

(Figure 1)

Euryptera costaricensis Melzer, 1935, Arch. Inst. Biologia Vegetal, **2**(2): 182.

Two specimens in the collection of the U.S. National Museum in Washington from San Jose, Costa Rica appear to be refer-

able to *M. costaricensis.* These are a little broader apically than *M. fulvella* and differ in coloration, the elytra having a broad ante-median black band and the apices broadly black, providing a *Calopteron*-like color pattern.

ACKNOWLEDGMENTS

The author is indebted to the National Science Foundation for making this and a number of related studies possible during his tenure as Research Professor, Miller Institute, University of California. Types of described species were kindly made available at the British Museum (Natural History), London, by E. B. Britton; at the California Academy of Sciences by E. S. Ross; at the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts by P. J. Darlington; at the Museum d'Histoire Naturelle, Paris, by André Villiers; and at the United States National Museum, Washington, D. C. by G. B. Vogt. J. N. Knull very kindly read the manuscript and made helpful suggestions regarding the species described by him.

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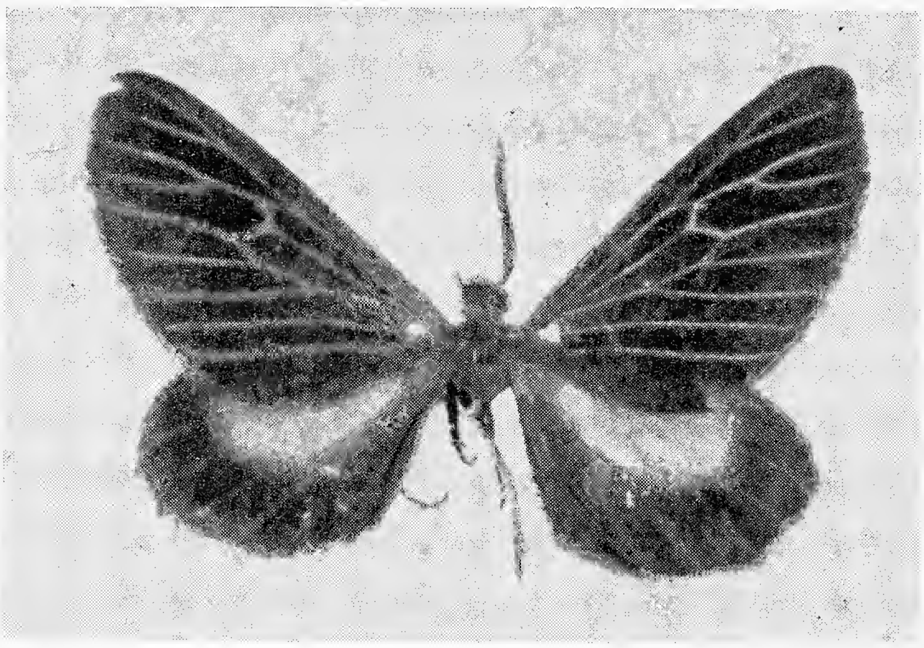
A NEW SPECIES OF MELANCHROIA (LEPIDOPTERA, GEOMETRIDAE) FROM JAMAICA

By Frederick H. Rindge
The American Museum of Natural History

A number of years ago Avinoff and Shoumatoff collected a single geometrid in Jamica, and the former was unable to find a name for it. He made some descriptive notes for this moth but these were never published. Some years after Avinoff's death, Mr. Shoumatoff brought the specimen and notes to me. The following description and illustrations are the result.



1. Holotype, *Melanchroia venata,* new species. ×2.

The author wishes to thank Mr. D. S. Fletcher, of the British Museum (Natural History), and Dr. E. L. Todd, of the United States National Museum, for help with this problem.

Melanchroia venata, new species

Male Head, vertex and front blackish-gray, the latter narrowly pale buff ventrally; palpi with first segment pale buff, terminal segments blackish-gray. Thorax orange-brown above, blackish-gray laterally, orange-brown below; legs with orange-brown coxae, terminal segments blackish-gray. Abdomen blackish-gray above, below with broad ocher stripe.

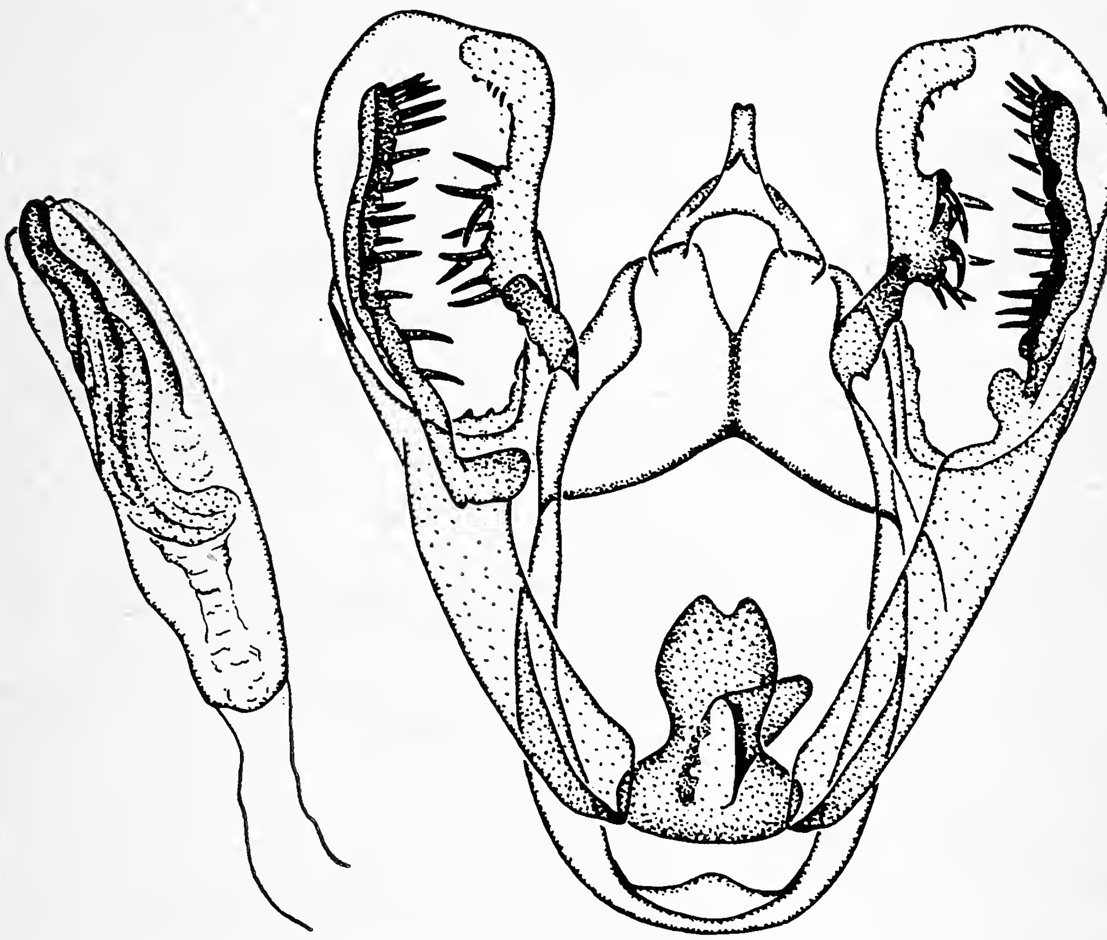
Upper Surface of Wings Forewings with elongate costal and outer margins, inner margin swollen; ground color dull blackish-gray, all veins

narrowly white except for Sc, R_{1+2} and R_3, and with narrow line through discal cell to dc; fovea transparent; fringe shiny, concolorous with wing. Hind wings with m-ldc cross vein sharply angled basad; central portion of wing pale buff, encircled by broad outer margin of dull blackish-gray; fringe as on forewings.

UNDER SURFACE OF WINGS Forewings dull blackish-gray, with area below cubital vein but not extending to outer margin pale buff; a few white scales on dc. Hind wings dull blackish-gray.

LENGTH OF FOREWING 17 mm.

FEMALE Unknown.



2. Male genitalia, *Melanchroia venata*, new species.

MALE GENITALIA Uncus tapering from base, apical portion attenuate, terminating in two small points; valves with costa sclerotized, having eight, heavy, inwardly directed spines on middle one-third of inner margin; ampulla membranous; sacculus broadly sclerotized, continued distally as elongate, sclerotized arm with 14 or 15 heavy spines arising from inner margin; anellus heavily sclerotized, apically bilobed and finely spinose; aedeagus with sclerotized cornutus, having large curve at base and much smaller curve at apex.

TYPE Holotype, male, taken in the underbrush on the slopes

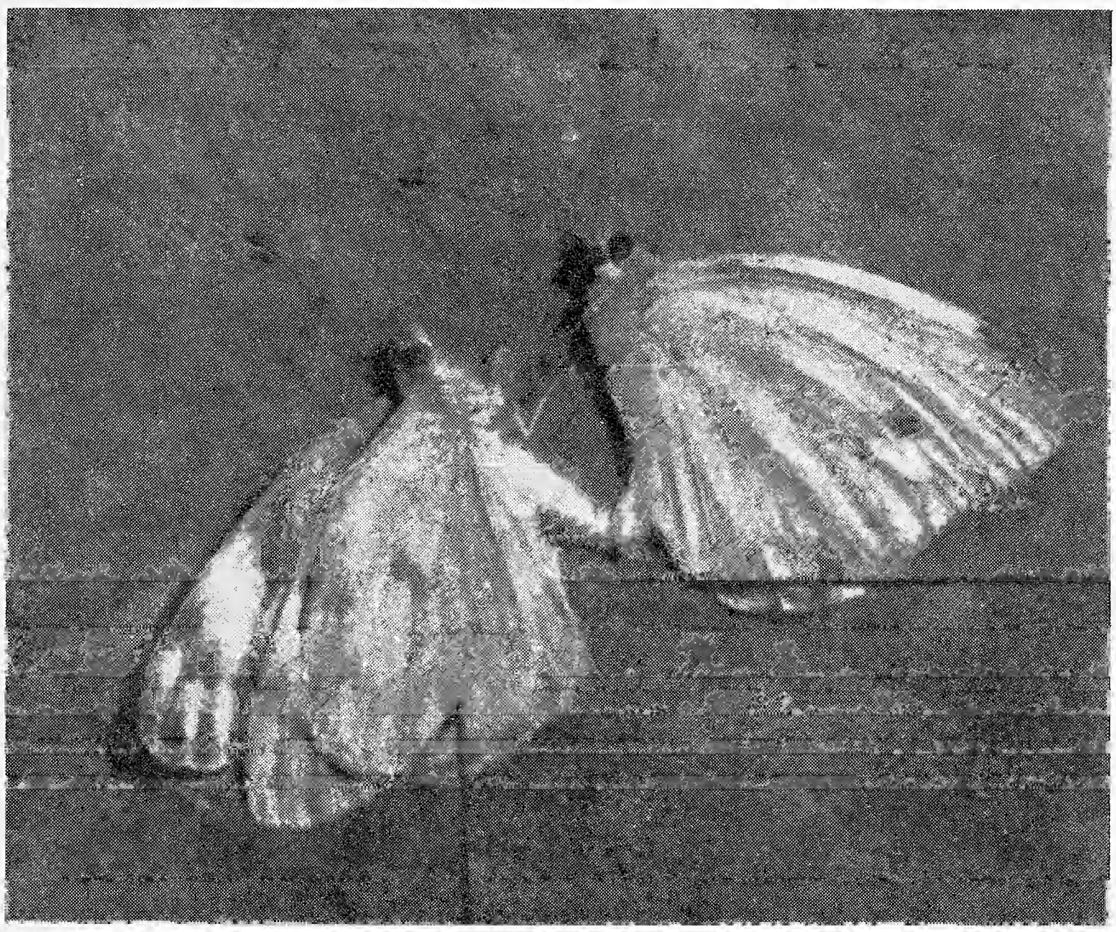
of a hill near Milk River Bath, Milk River, Jamaica, June 20, 1936 (Avinoff and Shoumatoff). In the collection of the Carnegie Museum.

This species can be distinguished from *cephise* Stoll and *geometroides* Walker by its more elongate forewings, by the white venation pattern, and by the pale central area of the hind wing. In the male genitalia the elongate uncus and the two areas of elongate spines in the valves are diagnostic.

PICTORIAL EVIDENCE OF INTERSPECIFIC BREEDING OF *PIERIS PROTODICE* BOISDUVAL AND LECONTE AND *PIERIS RAPAE* LINNAEUS (LEPIDOPTERA, PIERIDAE)

BY KURT B. GOHLA
FORDHAM UNIVERSITY, NEW YORK

On July 26, 1960 a rather rare interbreeding in nature, occurring between lepidoptera belonging to the same family but to



♀ *Pieris protodice* ♂ *Pieris rapae*

two different species, was accidentally encountered. A female native American Checkered White (*Pieris protodice* Boisduval and Leconte) and a male immigrant European Cabbage White (*Pieris rapae* Linnaeus) were noted in normal copulation. The pair rested on a wide blade of grass. When distrubed the female *Pieris protodice* took flight carrying the male *Pieris rapae,* contrary to reported normal performances, where in coition the male usually carries the female in flight. After a short distance they

were easily netted and placed in a killing jar. Both specimens seemed to be utterly exhausted. They did not separate and were preserved as shown in the photograph. The joined pair is now in my private collection. To keep them alive, as so urgently suggested in Dr. Klots' analogous report (Klots, 1959), did not seem practicable at that time.

Their habitat was an unused athletic field located at the Fordham University campus, Bronx, New York, presently overgrown in profusion with a variety of weeds and grasses, amongst them extended patches of blooming white clover, frequented by a numerous population of *Pieris rapae* L., *Pieris protodice* B. & L., *Colias eurytheme* Boisduval, and *Colias philodice* Latreille, of both sexes.

Several courtship flights and attempts at mating were observed that day, but always amongst specimens of their own respective species. The day was sunny, very warm, and humid. The concentration of these four types of Whites and Sulphures lasted for about a week, then all speciments of *Pieris protodice* seemed to have vanished.

Shortly after their capture the copulating specimens were verified by Dr. Louis Marks of the Fordham University Biological Laboratories. The photograph was taken by John P. Wourms, Graduate Assistant, Fordham University Biological Laboratories.

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NOTES ON THE MECISTORHINUS-ANTITEUCHUS GENERIC COMPLEX OF DISCOCEPHALINE PENTATOMIDS (HETEROPTERA, PENTATOMIDAE)

BY HERBERT RUCKES[1]

In the course of preparing a generic revision of the pentatomid subfamily Discocephalinae, one of the major problems confronting the author was that of differentiating the two Dallasian genera *Mecistorhinus* and *Antiteuchus* from one another. Dallas (1851) was rather lavish in his description of *Mecistorhinus* but contrastingly niggardly in his treatment of *Antiteuchus,* being content to establish the genus on the basis of merely two characters used in the couplets of a generic key. As a consequence there has always been considerable confusion regarding the exact identity of these two genera. Of course, since there are numerous species involved, the question of which species belongs to which genus naturally arises. The lack of detailed anatomical knowledge, or rather the lack of the application of it, has been responsible for the more or less chaotic situation in which we find ourselves at the present time.

It appears that only a few of numerous readily observable external characters had previously been used to distinguish these two genera from one another. Successive students of the group have added little to augment our previous knowledge and even as remarkable an hemipterist as Stål was, he relied upon such subtle features as the different degrees of convexity of the body in order to establish subgeneric divisions. We know that such a character as curvature or convexity is a rather weak one since it is subject to varying interpretation, depending upon the individual student. During the course of the present research all possible morphological characters of these insects were studied in great detail and their uses as diagnostic characters evaluated; especial attention was given to the composition of

[1] Research Associate, Department of Entomology, the American Museum of Natural History, and Professor Emeritus, the City College of New York.
The work for the present paper was done under the auspices of the National Science Foundation.

the male and female external gentialia to determine their similarities and their contrasts. A number of new characteristics have been discovered that appear to add materially to our better understanding of the differences between these genera.

In his final work on the Discocephalinae, Stål (1872) used Burmeister's genus *Dinocoris* as the taxomic basis for the analysis of the complex under consideration in this paper. He broke *Dinocoris* down into three subgenera, to wit, *Dinocoris* (sens. typ.), *Mecistorhinus,* and *Antiteuchus.* Into the first he placed the species *Pentatoma macraspis* Perty and *Antiteuchus variegatus* Dallas, both of which were subsequently transferred to the genus *Neodine* Kirkaldy. In the subgenus *Mecistorhinus* he included eight species, only two of which rightfully belong there, whereas in the subgenus *Antiteuchus* he placed only two of ten then known species, the others either being assigned to *Mecistorhinus* or left unassigned for want of better information concerning them. No changes were made in this arrangement until Kirkaldy published his Catalogue (1909); he followed Stål's lead, added a new species that had been described since Stål's time, and erected the genus *Neodine* to take care of the above-mentioned species *macraspis* and *variegatus,* which do not at all belong in the genus *Dinocoris* Burmeister. Thus the situation has existed up to the present time.

For the purpose of clarifying the problem in my own mind and of possibly contributing a little aid (or possibly confusion) to future students of these pentatomids, the following summary of observations is being presented. The study was made possible through partial use of a grant-in-aid (#G–9830) from the National Science Foundation which was given for the larger project, that of revising the subfamily Discocephalinae. In the course of this study various European as well as American museums were visited and, before coming to the conclusion embodied in this article, as many species and as many specimens of *Mecistorhinus*, *Antiteuchus*, and *Neodine* were examined as were available in those different institutions.

In spite of the rather lengthy description given by Dallas for *Mecistorhinus* only three characters used by him are really pertinent to a generic study. These are: a) the ratio of the length of the head to its width, b) the length of the rostrum, and c) the proportional lengths of the antennal segments. Funda-

mentally these are important, for they do, in part, distinguish *Mecistorhinus* from *Antiteuchus,* but there are other, and I believe equally good or even better, characters that, when used in conjunction with those just mentioned, will clearly demark the two genera and establish their respective identities. In the latter category I would include such characters as the nature of the apical margin of the terminal abdominal tergite in the male insect; the size of the scutellum and the length of the frenum; the length of the corium with respect to the length of the scutellum; the ratios of the rostral segmental lengths; the form and special features of the mesosternum; the form of the basal plates of the female genital valves; and the construction of the gential capsule in the male, with particular attention given to the composition of the proctiger and the form of the heads of the parameres or claspers.

Genus *Mecistorhinus* Dallas

With these items in mind let us first analyze *Mecistorhinus,* given the following diagnosis:

HEAD Averaging one-third longer medially than wide across the greatest diameter (which is just in front of the eyes), surface concave, the margins broadly and sometimes very strongly reflexed, in some species so much so as to produce a scoop-shaped form; very weakly, if at all, sinuate before the eyes and then gradually converging to a rounded apex, frequently with a small apical sinus between the overlapping juga. ANTENNAE Only moderately long, not reaching the middle of the scutellum nor the area where the frena end; basal segment shorter than segment II, the latter always much more than half of the length of segment III, usually subequal with it. SCUTELLUM Reaching the fifth abdominal tergite in the female, and in the male not attaining the apex of the terminal tergite; the frena end just a slight distance beyond the middle. HEMELYTRA Corium always exceeding the apex of the scutellum by about the length of one connexival segment. ROSTRUM very long, nearly reaching the apex of the abdomen, in the female attaining, at least, the base of the sixth abdominal sternite and in the male reaching the middle of the seventh segment; in at least two species the rostrum is longer than the entire body; apex of segment II reaching, at least, the metacoxae, in some species exceeding it, segments III and IV subequal or segment IV a little longer. MESOSTERNUM Somewhat bilaterally tumid, at least anteriorly, and there shallowly sulcate longitudinally, the sulcus evanescent posteriorly and there replaced with a thin, low, median carina; the apical margin of the segment truncate. METASTERNUM Narrowly hexagonal with a low, thin, median carina. TERMINAL ABDOMINAL TERGITE IN THE MALE (Fig. 1) The apical margin forming one continuous transverse concave arc without a median retrorsely

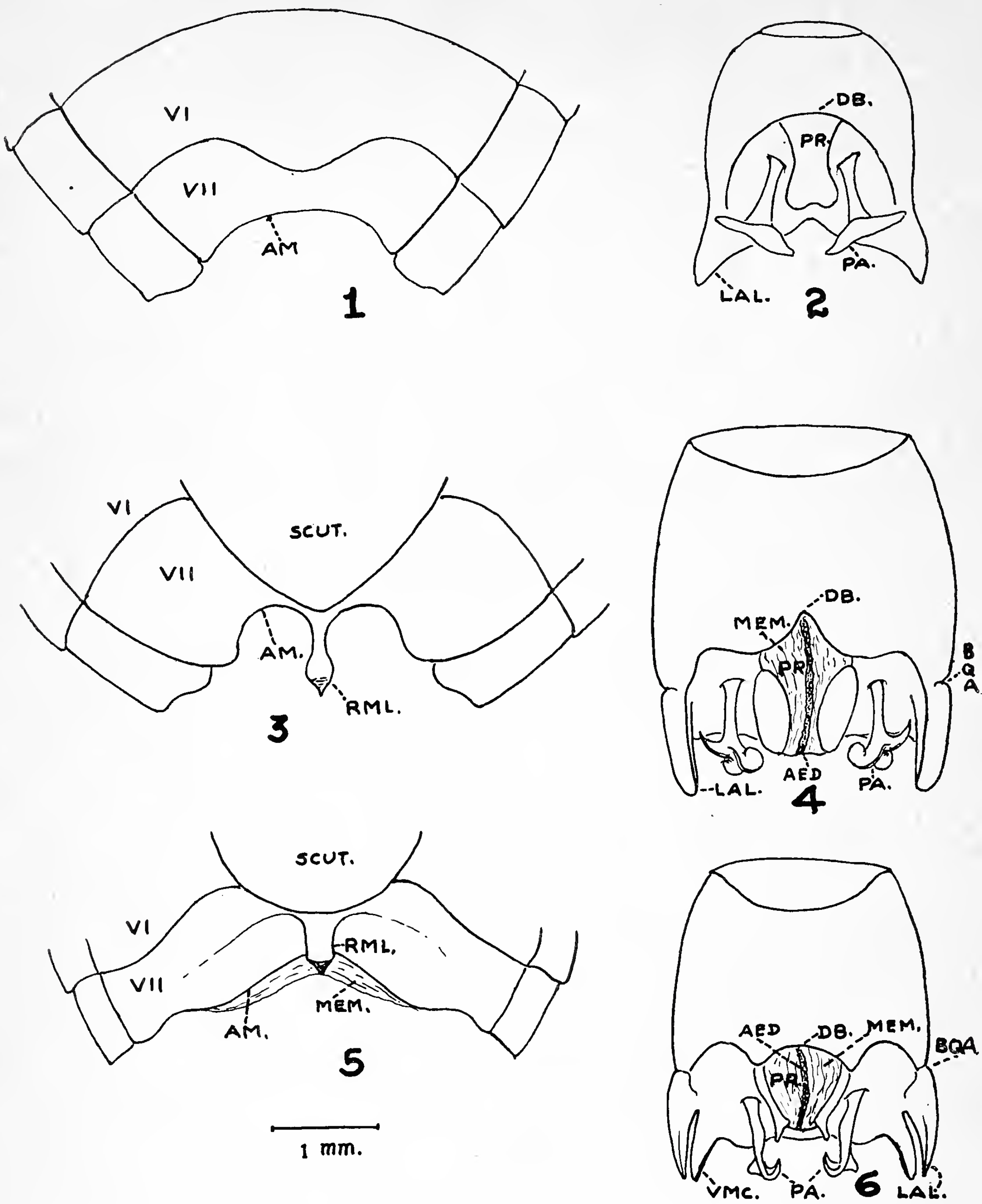

FIG. 1. *Mecistorhinus obscurus* Dallas, showing 6th and 7th tergites in male.

FIG. 2. *Mecistorhinus obscurus* Dallas, the pygophore of the male.

FIG. 3. *Antiteuchus panamensis* Ruckes, showing 6th and 7th tergites in male.

FIG. 4. *Antiteuchus panamensis* Ruckes, the pygophore of the male.

FIG. 5. *Callostethus guttatopunctatus* (Fabr.) showing 6th and 7th tergites in male.

FIG. 6. *Callostethus guttatopunctatus* (Fabr.), the pygophore of the male.

ABBREVIATIONS: AED.—aedeagus; AM.—apical margin of 7th tergite; BQA.—basal quasi articulation; DB.—dorsal border; LAL.—lateral apical lobes; MEM.—membrane; PA.—paramere; PR.—proctiger; RML.—retrorse median lobe; SCUT.—apex of scutellum; VMC.—ventral marginal cusp.; VI and VII—the sixth and seventh tergites.

produced lobe or process. EXTERNAL MALE GENITALIA (Fig. 2) Dorsal border of the capsule very shallowly sinuate or, more usually, not sinuate at all; each lateral apical lobe acute, retrorsely produced and apically divergent, broadly attached to the wall of the capsule without evidence of any articulatory joint; proctiger completely sclerotized dorsally, somewhat dilated apically into two small, divergent lobes; all parts of the aedeagus obscured from the dorsal aspect; heads of the parameres transverse, stoutly irregular fusiform and lying obliquely across the lateral apical lobes of the capsule. EXTERNAL FEMALE GENITALIA Basal plates of the valves subtriangular, about as long as wide, their angles rounded, their apical margins taken together forming a continuous transverse arc across the abdomen.

To this genus belong the following currently known species: *rufescens* Dallas (type species); *semilugens* Bergroth; *coralium* Ruckes; *complanatus* (Distant); *josephi* Stål; *tibialis* Ruckes; *obscurus* Dallas; *quatemalensis* (Distant);

Several new species are in the process of being described and will eventually be added to the above list.

Genus *Antiteuchus* Dallas

Contrast now the genus *Antiteuchus* with the following characteristics:

HEAD Subsequal in length medially to the greatest width just before the eyes, the surface flattish, no evidence of any broadly reflexed margins, the margins before the eyes distinctly sinuate, then subparallel and/or sigmoidal, the apex rather evenly and broadly rounded, apparently without a minute incisure between the overlapping juga. ANTENNAE More than moderately long, reaching beyond the middle of the scutellum, and usually past the area where the frena end; segment II usually shorter than segment I, seldom longer, but then never more than half the length of segment III, most commonly much shorter than segment III, at times no more than one-fifth as long, never subequal to it. SCUTELLUM (Fig. 3) Reaching beyond the fifth abdominal tergite in the female and usually attaining the apical margin of the terminal tergite in the male; the apex more angularly rounded, sometimes subtriangular in outline; frena ending past the middle as in *Mecistorhinus.* HEMELYTRA Corium exceeding the apex of the scutellum but ordinarily by less than the length of the adjacent connexival segment. ROSTRUM Only moderately long, never reaching to the anterior margin of the fifth abdominal tergite in either sex; apex of segment II hardly surpassing the mescoxae, more commonly just reaching them; segment IV always a little shorter than segment III. MESOSTERNUM Usually feebly tumid, not distinctly sulcate anteriorly, but becoming weakly carinate posteriorly, much as in *Mecistorhinus.* METASTERNUM Narrowly hexagonal with a low, thin carina, much as in *Mecistorhinus.* TERMINAL ABDOMINAL TERGITE IN THE MALE (Fig. 3) Apical margin transversely arcuate, not broadly deflexed or impressed, interrupted in the middle and there

provided with a retrorse flat, narrow, linguiliform, hastiform, spatulate, or filiform process, which arises from the extreme margin of the segment or near it; the apex of this process is usually strongly deflexed and transversely rugose. EXTERNAL MALE GENITALIA (Fig. 4) Dorsal border of the capsule deeply sinuate centrally, frequently triangularly so; each lateral apical lobe retrorsely produced, obtuse, stubby and usually digitiform, the ental surface concave, more or less parallel to each other or incurved, never divergent apically; each lobe is attached to the capsule by a distinct basal quasi articulation; proctiger sclerotized only on the lateral surfaces, the dorsal median portion being membranous, through which parts of the aedeagus are visible from above; the posterior ends of the sclerotized sides (at the crest) usually somewhat bulbous with small protruding lobes, or at least tumid; heads of parameres facing posteriorly or slightly laterally, not overlaying the lateral apical lobes of the capsule; the heads, at least, trilobed, the lobes partially twisted and in some species resembling minute propellers. EXTERNAL FEMALE GENITALIA Basal plates of the valves subtrapezoidal, somewhat wider than long, their apical margins truncate and taken together forming more or less a straight line which is subparallel to the apical margin of the abdomen.

To this genus belong the following currently known species: *variolosus* (Westwood) (type species); *melanoleucus* (Westwood); *piceus* (Palisot de Beauvois); *mixtus* (Fabricius); *marmoreus* (Spinola); *panamensis* Ruckes; *tripterus* (Fabricius); *sepulcralis* (Fabricius); *peruensis* Ruckes; *marmoratus* Erichson; *tesselatus* (Westwood); *punctiger* (Westwood); *annulicornis* (Fieber).

Seven or eight new species of *Antiteuchus* are in the process of being described and will eventually be added to this list.

Through the kindness of Dr. J. O. Husing of the Martin Luther Universität zu Halle, I was privileged to study Fieber's type of *Marcothyreus annulicornis* which was sent me while I was working at the British Museum. The generic name *Macrothyreus* being preoccupied, Kirkaldy eventually assigned this species to the genus *Grimgerda* Kirkaldy. Intensive examination of this type specimen indicates that it is merely a species of *Antiteuchus* and does not merit generic status of its own. Every character set forth above for *Antiteuchus* fits the species *annulicornis*; hence hereafter this discocephaline should be known as *Antiteuchus annulicornis* (Fieber).

Subgenus **Neodine** Kirkaldy, new taxon

The genus *Neodine* Kirkaldy conforms to all the requirements set down for *Antiteuchus,* including the form of the lobate parameres and the re-

trorsely produced process arising from the extreme margin of the terminal abdominal tergite in the male. The basal plates of the female genital valves are provided with mildly sinuate apical margins, but since their form is subtrapezoidal and they are wider than long, they closely resemble those found in *Antiteuchus*. *Neodine* does possess, however, a very long scutellum with a narrowed, long postfrenal portion and an acutely rounded, subtriangular apex which nearly reaches the tip of the abdomen in both sexes. The most critical examination of the three known species of *Neodine* does not reveal enough difference between them and the numerous species of *Antiteuchus*, aside from the different forms of the scutellum, to warrant the retention of full generic status for *Neodine*. With these facts in mind it is deemed advisable now to reduce *Neodine* to subgeneric rank within the genus *Antiteuchus*.

To this subgenus belong the following currrently known species: *macraspis* (Perty), *variegatus* (Dallas), and *tatei* Ruckes.

Genus **Callostethus**, new genus

Turning attention now to the species variously classified as *Mecistorhinus guttatopunctatus* (Fabricius) or *Antiteuchus guttatopunctatus* (Fabricius), we are faced with an entirely different problem. This species has some of the characteristics prescribed for *Antiteuchus* (none for *Mecistorhinus*) but differs in several major respects.

The HEAD, ANTENNAE, and ROSTRUM are similar, but the SCUTELLUM (Fig. 5) is less angularly rounded at the apex and less sinuate along the lateral margins. Other and more critical characters differ as follows: HEMELYTRA Corium surpassing the apex of the scutellum by the length of one connexival segment. MESOSTERUM Not bilaterally tumid, barely elevated, but provided with a percurrent, low, obtuse, subcalloused ridge, which is somewhat fusiform in outline and which continues onto the metasternum as a thin median carina; the apical margin of the mesosternum is very narrow, almost angulate. METASTERNUM Essentially rhomboidal, rather than narrowly hexagonal, anterior and posterior margins very narrow, almost angulated, and, as stated above, provided with a thin low median carina. TERMINAL ABDOMINAL TERGITE IN THE MALE (Fig. 5) Apical margin broadly deflexed and strongly impressed, bordered by a wide membrane; the retrorsely produced median lobe is short and arises from nearer the center of the disc rather than from the extreme apical margin as in *Antiteuchus* and *Neodine*, and its triangular apex is abruptly deflexed and not transversely rugose. MALE EXTERNAL GENITALIA (Fig. 6) Dorsal border of the capsule very shallowly, but distinctly, sinuate centrally; lateral apical lobes cuneiform, subparallel, retrorsely produced, with a distinct basal quasi articulation, as in *Antiteuchus*, but each lying parallel and subequal to an acutely rounded, retrorse, long cusp (VMC) developed from each lateral end of the ventral apical margin of the capsule, thus giving the false

impression that the lateral apical lobes are compounded of two members, i.e., a dorsal and a ventral part; proctiger sclerotized only laterally, the dorsal median portion membranous through which parts of the aedeagus are visible from above; the sclerotized lateral plates are projected beyond the apical surface (crest) of the proctiger into small, flat, triangular lobes; parameres uncinate or hook-shaped, deflexed over the ventral apical margin of the capsule, where their very acute apices tend to converge, different in superficial appearance from those found in *Mecistorhinus* and quite dissimilar to those seen in *Antiteuchus*. EXTERNAL FEMALE GENITALIA Basal plates of the female valves transversely suboval, their apical margins taken together forming a feeble arc subparallelto the apex of the abdomen. ANTERIOR PRONOTAL MARGINS Not weakly elevated, without a posteriorly adjacent short impressed groove, such as is found in *Mecistorhinus, Antiteuchus,* and *Neodine.*

Altogether there are far greater differences between *guttatopunctatus* and any species of *Mecistorhinus* and *Antiteuchus* than are found between the species of *Neodine* and the species of *Antiteuchus*. Therefore if, as proposed, *Neodine* is reduced to subgeneric rank, then a new generic name should be created for the species *guttatopunctatus* to elevate it to a higher status than it now enjoys. To this end I propose the name *Callostethus*, to signify the presence of the calloused ridge on the mesosternum, and suggest that hereafter this species be called *Callostethus guttatopunctatus* (Fabricius).

In summary the following table shows the differences between the several genera in this complex:

Structure	*Mecistorhinus*	*Antiteuchus* and *Neodine*	*Callostethus*
HEAD			
Length to width	Longer than wide	Subequal or shorter	Subequal or shorter
Surface	Somewhat concave, margins reflexed	Flattish, margins not reflexed	Flattish, margins not reflexed
Margin before the eye	Barely sinuate, if at all	Distinctly sinuate	Distinctly sinuate
ANTENNAE			
Length	Do not reach the middle of scutellum	Exceed the middle of scutellum	Exceed the middle of scutellum
Ratio of segment II to III	Usually subequal; II always more than half of the length of III	Segment II always much shorter; never more than half of III	Segment II less than one-fifth of the length of III

ROSTRUM			
Length.	Nearly reaches the apex of abdomen; sometimes exceeds it	Does not exceed the middle of the abdomen	Does not exceed the middle of the abdomen
Ratio of segment III to IV	Subequal, or segment IV a little longer	Segment IV always slightly shorter than segment III	Segment IV always slightly shorter than segment III
MESOSTERNUM	Bilaterally mildly tumid; anteriorly sulcate, posteriorly feebly carinate	Bilaterally mildly tumid; anteriorly sulcate, posteriorly feebly carinate	Not bilaterally tumid; a percurrent median obtuse, subcalloused ridge present
METASTERNUM	Narrowly hexagonal, medially carinate	Narrowly hexagonal, medially carinate	Equilaterally rhomboidal, medially carinate
TERMINAL ABDOMINAL TERGITE IN MALE	Apical margin not deflexed, forming a continuous, even, transverse arc	Apical margin not broadly deflexed or impressed; a retrorse median lobe arising from the extreme apical margin	Apical margin broadly deflexed and impressed, with the retrorse median lobe arising from the surface of the disc, remote from the apical margin
MALE GENITALIA			
Dorsal border of capsule	Not sinuate centrally	Deeply sinuate centrally	Mildly, but distinctly sinuate centrally
Lateral apical lobes of capsule	Retrorsely produced, acutely triangular, broadly attached at base without a quasi articulation; apices divergent	Digitiform, inwardly concave, basally with a quasi articulation; subparallel or convergent or incurved	Cuneiform, subacute; basally with a quasi articulation; parallel to a large acute cusp developed from the lateral ends of the ventral margin of the capsule
Proctiger	Completely sclerotized aedeagus obscured from above	Median dorsal portion membranous, aedeagus in part visible from above	Median dorsal portion membranous, aedeagus in part visible from above

Parameres (Heads of)	Transverse, fusiform, placed obliquely across the lateral apical lobes	Multilobate, lobes, partially twisted, facing posteriorly free from the lateral apical lobes	Uncinate or acutely hooked, deflexed over the ventral apical margin of the capsule, apices convergent
FEMALE GENITALIA			
Basal plates	Subtriangular, apical margins taken together forming a transverse arc	Subtrapezoidal, apical margins taken together forming a more or less transverse straight or mildly sinuate line, subparallel to the apical margin of the abdomen	Subtrapezoidal or suboval, apical margins taken together forming a more or less transverse straight line, feebly arcuate, subparallel to the apical margin of the abdomen
ANTERIOR PRONOTAL MARGIN	Weakly elevated and subtended by a short impressed, transverse groove	Weakly elevated and subtended by a short impressed, transverse groove	Not elevated, the short transverse, impressed groove behind the margin lacking

Literature cited

DALLAS, WILLIAM S. 1851. List of Hemiptera; 152, 162, and 163.

FABRICIUS, J. C. 1803. Systema Rhyngotorum; 152.

FIEBER, FRANCIS X. 1851. Rhyngographien; Abh. böhm, Gesell. Wissenschaften; **7**: 457.

KIRKALDY, GEORGE W. 1909. Catalogue of Hemiptera; **I**: 217.

STÅL, CARLOS. 1872. Kong. Svenska Vetens. Akad. Handlingar **10**: 4: 7.

AN ANNOTATED LIST OF THE LYCAENIDAE (LEPIDOPTERA: RHOPALOCERA) OF THE WESTERN HEMISPHERE

BY WILLIAM PHILLIPS COMSTOCK AND EDGAR IRVING HUNTINGTON

[Continued]

mcdunnoughi Gunder, Jean D., *Lycaena snowi* tr. f.
Type Locality: Laggan, Alberta, July 20, 1904.
Location of Type: Canadian National Collection, Ottawa, Ontario.
Original Description: 1927 (December), Can. Ent., vol. 59, p. 284, pl. A, fig. 12 (Orillia, Ont.).

mcdunnoughi Gunder, Jean D., *Glaucopsyche lygdamus couperi* tr. f.
Type Locality: Saskatchewan, Canada.
Location of Type: United States National Museum, Barnes Collection.
Original Description: 1927, (December), Can. Ent., vol. 59, p. 282, pl. A, figs. 4, 4a (Orillia, Ont.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 28, no. 473 (Los Angeles, Calif.). (Places "*macdunnoughi*" as an aberration of *lygdamus couperi* Grote.)

macaria Swainson, William, *Thecla*
Type Locality:
Location of Type:
Original Description: 1822, Zool. Illus., vol. 3, pl. 133 (London).
Additional Reference: Kirby, W. F., 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 388, no. 149 (London). (Places *macaria* in the synonymy of *rustan* Stoll.)

macdunnoughi, McDunnough, James H., *Lycaena snowi* ab. Misspelling of *mcdunnoughi*
Type Locality:
Location of Type:
Original Description: 1938, Check list, pt. 1, p. 26, no. 437 (Los Angeles, Calif.).

maculata Lathy, Percy I., *Thecla*
Type Locality: Huancabamba, Peru.
Location of Type: Fournier Collection, Paris.
Original Description: 1936, Livre jubilaire de M. Eugène-Louis Bouvier, p. 230, pl. 8, fig. 8 (Paris).

maculata-suffusa Cockle, J. W. *Cyaniris ladon* var.
Type Locality: Bala Lake, Quesnelle, Northern British Columbia.

Location of Type:
Original Description: 1910 (June), Can. Ent., vol. 42, p. 204 (London, Ont.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 29, no. 475 (Los Angeles, Calif.). (Places *maculata-suffusa* as a synonym of *quesnellii* Cockle.)

maculinita Gunder, Jean D., *Heodes cupreus* ab.
Type Locality: Mammoth, Mono County, California.
Location of Type: American Museum of Natural History.
Original Description: 1926 (*January*), Ent. News, vol. 37, p. 8, pl. 1, fig. 11 (Philadelphia, Pa.).

madie Weeks, A. G., Jr., *Thecla*
Type Locality: Suapure, Venezuela.
Location of Type: Museum of Comparative Zoology.
Original Description: 1906 (June), Ent. News, vol. 17, p. 197 (Philadelphia, Pa.).
Additional Reference: Weeks, A. G., Jr., 1911, Illus. of Diurnal Lepidoptera, vol. 2, p. 3, pl. 3, fig. 1 (Boston, Mass.).
Synonyms: *maidie* Weeks.

maeonis Godman, F. D. and O. Salvin, *Thecla*
Type Locality: San Gerónimo, Guatemala.
Location of Type: British Museum (Natural History).
Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 70, vol. 3, pl. 56, figs. 22, 23 ♂ (London).

maesites Herrich-Schäffer, G. A. W., *Thecla*
Type Locality: Cuba.
Original Description: 1864, Corresp.-Blatt Zool.-Min. Ver., vol. 18, p. 165 (Regensburg).
Additional References: Draudt, Max. 1920, The Macrolepidoptera of the World, vol. 5, p. 798 (Stuttgart). (As *moesites.*) Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 72 (New York). Comstock, W. P., 1944 (October). Scientific Survey of Porto Rico and the Virgin Islands, vol. 12, pt. 4, p. 487, pl. 9, fig. 6 ♀ (New York).
Synonyms: *moesites* Draudt.
Subspecies: *clenchi* Comstock and Huntington, *telea* Hewitson.

maevia Godman, F. D. and O. Salvin, *Thecla*
Type Locality: San Gerónimo, Guatemala.
Location of Type: British Museum (Natural History).
Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 89, vol. 3, pl, 58, figs. 3, 4 ♂ (London).
Additional Reference: Stallings, D. B. and J. R. Turner, 1947 (February), Ent. News, vol. 58, p. 39 (Philadelphia, Pa.). (Places *maevia* as winter form of *clytie* Edwards, therefore a synonym.)

maidie Weeks, A. G., Jr., *Thecla* Misspelling of *madie*
Type Locality:
Location of Type:
Original Description: 1911, Illus. of Diurnal Lepidoptera, vol. 2, p. 3 (Boston, Mass.).

major Lathy, Percy I., *Thecla rocena*
Type Locality: Muzo, Colombia.
Location of Type: Fournier Collection, Paris.
Original Description: 1926, Ann. Mag. Nat. Hist., Series 9, vol. 17, p. 42 (London).

m-album Boisduval, Jean A. and John LeConte, *Thecla*
Type Locality: Georgia.
Location of Type:
Original Description: 1833, Histoire Générale et iconographie des Lépidoptères et des chenilles de l'Amérique Septenthrionale, p. 86, pl. 26 (Paris).
Synonyms: *psyche* Boisduval and LeConte.

malcolmi Gunder, Jean D., *Plebeius monticola* ab. ♀
Type Locality: Ridge Route, Los Angeles County, California, May 30, 1922.
Location of Type: American Museum of Natural History.
Original Description: 1925 (July), Ent. News, vol. 36, p. 195, pl. V, fig. 2 (Philadelphia, Pa.).

malcolmi Gunder, Jean D., *philotes glaucon intermedia* tr. f.
Type Locality: American River, Placer County, California, July 19, 1921.
Location of Type: American Museum of Natural History.
Original Description: 1927 (December), Can. Ent., vol. 59, p. 282, pl. A, fig. 5 (Orillia, Ont.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 28, no. 466 (Los Angeles, Calif.). (Places *malcolmi* as an abbration of *glaucon intermedia* Barnes and McDunnough.)

malina Hewitson, W. C., *Thecla*
Type Locality: Brazil.
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 88, vol. 2, pl. 34, figs. 69, 70 ♂ (London).

malta Schaus, William, *Thecla*
Type Locality: Peru.
Location of Type: United States National Museum, no. 5928.
Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 410 (Washington, D. C.).
Additional Reference: Draudt, Max, 1920 (January), The Macrolepidoptera of the World, vol. 5, p. 800, pl. 158-g (Stuttgart).

malvania Hewitson, W. C., *Thecla*
Type Locality:
Location of Type: British Museum (Natural History).

Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 95, vol. 2, pl. 38, figs. 106, 107 ♂ (London).

malvina Hewitson, W. C., *Thecla*
Type Locality: Rio de Janeiro, Brazil.
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 93, vol. 2, pl. 37, figs. 102, 103 ♂ (London).

mansfieldi Tilden, J. W., *Mitoura siva*
Type Locality: 7 miles west of Simmler, San Luis Obispo County, California, March 21, 1940.
Location of Type: California Academy of Sciences, San Francisco, California.
Original Description: 1951 (May–August), Bull. Southern Calif. Acad. Sci., vol. 50, pt. 2, p. 96, pl. 33 (Los Angeles, Calif.).

mantica Druce, Hamilton H., *Thecla*
Type Locality: Chapada Campo, Brazil (September and November).
Location of Type: Godman Collection.
Original Description 1907 (June), Proc. Zool. Soc. London, p. 616, pl. 36, figs. 16 ♂, 17 ♀ (London).

maraches Druce, Hamilton H., *Thecla*
Type Locality: Banos, Río Pastaza, East Ecuador, 5000–7000 ft.
Location of Type: Druce Collection (♂).
Original Description: 1912 (June), Ent. Mo. Mag., vol. 23, Series 2, p. 130, pl. X, fig. 2 (London).

margaretae dos Passos, Cyril F., *Incisalia henrici*
Type Locality: Deland, Florida, March 3, 1932.
Location of Type: American Museum of Natural History.
Original Description: 1943 (June), Amer. Mus. Novitates, no. 1230, p. 4 (New York, N. Y.).

margarita Draudt, Max, *Thecla*
Type Locality: Río Songo, West Bolivia.
Location of Type:
Original Description: 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 793, pl. 157-i (Stuttgart).

margaritacea Draudt, Max, *Thecla*
Type Locality: Muzo, Colombia (1 ♂).
Location of Type: Fassl Collection (now in Naturhistorisches Museum, Basle).
Original Description: 1919 (December), The Macrolepidoptera of the World, vol. 5, p. 755, pl. 153-b (Stuttgart).

marginata Edwards, William H., *Lycaena pseudargiolus* form
Type Locality: New York, New England and Quebec.

Location of Type:
Original Description: 1883 (July), Papilio, vol. 3, p. 87 (New York).

marialis Clench, Harry K., *Thecla*
Type Locality: Victoria, Mexico, February 7, 1942.
Location of Type: Museum of Comparative Zoology, no. 26, 569.
Original Description: 1944 (July), Bull. Mus. Comp. Zool., vol. 94, p. 244 (Cambridge, Mass.).

maricopa Reakirt, Tryon, *Lycaena*
Type Locality: California.
Location of Type: Strecker Collection (1 ♀), Field Museum, Chicago, Illinois.
Original Description: 1866 (June), Proc. Acad. Nat. Sci. Phila., p. 245 (Philadelphia, Pa.).
Additional Reference: Barnes, William and J. H. McDunnough, 1917 (February), Check list of the Lepidoptera of Boreal America, p. 16, no. 433 (Decatur, Illinois). (Place *maricopa* female as a synonym of *icarioides* Boisduval.)
Synonyms: *windi* Gunder.

marina Reakirt, Tryon, *Lycaena*
Type Locality: Orizaba and near Vera Cruz, Mexico.
Location of Type: Strecker Collection (1 ♂, 1 ♀).
Original Description: 1868, Proc. Acad. Nat. Sci., Phila., vol. 20, p. 87 (Philadelphia, Pa.).
Additional References: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 94 (New York). Comstock, W. P., 1944 (October), Scientific Survey of Porto Rico and the Virgin Islands, vol. 12, pt. 4, p. 495, pl. 9, fig. 13 ♂ (New York).
Synonyms: *cassioides* Boisduval, *reakirti* Field, *violacea* Gunder.
Subspecies: *burdicki* Henne, *cassidula* Boisduval.

mariposa Reakirt, Tryon, *Polyommatus*
Type Locality: California.
Location of Type: Strecker Collection (3 ♂, 1 ♀).
Original Description: 1866 (June), Proc. Ent. Soc. Phila., vol. 6, p. 149 (Philadelphia, Pa.).
Synonyms: *zeroe* Boisduval.
Subspecies: *penroseae* Field.

maritima Weeks, A. G., Jr., *Lycaena*
Type Locality: Lower California.
Location of Type: Museum of Comparative Zoology.
Original Description: 1902, Proc. N. E. Zool. Club, vol. 3, p. 12 (Cambridge, Mass.).
Additional Reference: Weeks, A. G., Jr., 1905, Illus. of Diurnal Lepidoptera, p. 102, pl. 44, fig. 3 (Boston, Mass.).

marius Lucas, P. H., *Thecla*
Type Locality: "Cuba".

Location of Type:

Original Description: 1857, *in* Sagra, Historie physique, politique et naturelle de l'ile de Cuba, vol. 7, p. 599 (Paris).

Additional Reference: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 56 (New York). (Did not recognize the species.)

mamoris Druce, Hamilton H., *Thecla*

Type Locality: Colombia (♂).

Location of Type: British Museum (Natural History).

Original Description: 1907 (June), Proc. Zool. Soc. London, p. 604 (London).

mars Fabricius, Johann Christian, *Papilio*

Type Locality: "In America Meridionali".

Location of Type:

Original Description: 1777, Genera Insectorum, p. 268 (Chilonii).

Additional References: Hübner, Jacob, 1823, Sammiung exotischer Schmetterlinge, vol. 2, pl. (89) Augsburg). Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 63, pl. 1, fig. 5 ♀ (New York). (Make *mars* a subspecies of *acis* Drury.)

marsyas Linnaeus, Carolus, *Papilio*

Type Locality: "In Calidis regionibus".

Location of Type:

Original Description: 1758, Systema Naturae, 10th Edition, p. 482 (Upsaliae).

Additional Reference: Clerck, Alexander, 1759–1764, Icones, pl. 41, fig. 1 (Holmiae).

Subspecies: *cybele* Godman and Salvin.

martha Dognin, P., *Lycaena*

Type Locality: Loja, Ecuador.

Location of Type:

Original Description: 1887 (November), Le Naturaliste, Series 2, no. 16, p. 190, fig. 5 (Paris).

Additional Reference: Dognin, P., 1887, Note sur la Faune des Lépidoptères de Loja, p. 24, pl. 2, figs. 6-a, 6-b (Paris).

martialis Herrich-Schäffer, G. A. W., *Thecla*

Type Locality: Cuba.

Location of Type:

Original Description: 1864, Corresp.-Blatt Zool.-Min. Ver., vol. 18, p. 164 (Regensburg).

Additional Reference: Hewitson, W. C., 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 156, vol. 2, pl. 62, figs. 418, 419 ♂ (London). Cuba and Jamaica.

martini Mattoni, R. H. T., *Philotes battoides*

Type Locality: Oatman, Mohave County, Arizona, April 17, 1948.

Location of Type: United States National Museum.
Original Description: 1954 (December), Bull. Southern Calif. Acad. Sciences, vol. 53, pt. 3, p. 157, pl. 43, figs. 3, 4 (Los Angeles, Calif.).

mathewi Hewitson, W. C., *Thecla*
Type Locality: Mexico.
Location of Type: British Museum (Natural History).
Original Description: 1874, Ent. Mo. Mag., vol. 11, p. 106 (London).
Additional References: Hewitson, W. C., 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 196, vol. 2, pl. 78, figs. 629, 630 ♂ (London). Mexico. Godman, F. D. and O. Salvin, 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 90 (London). (Say that the type was obtained on the West Coast of Mexico and add Guatemala and Panamá.)

matho Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Carimang River, British Guiana.
Location of Type: British Museum (Natural History).
Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 80 (London).

mavors Hübner, Jacob, *Theritas*
Type Locality: Surinam.
Location of Type:
Original Description: 1818, Zuträge, zur Sammlung exotischer Schmettlinge, vol. 1, p. 31, pl. (33), figs. 189, 190 (Augsburg).

mazurka Hewitson, W. C., *Thecla*
Type Locality: Amazon.
Location of Type: British Museum (Natural History).
Original Description: 1869, Illus. of Diurnal Lepidoptera, vol. 1, p. 79, vol. 2, pl. 31, fig. 33 ♀ (London).

meadi Field, William D., *Lycaena editha* race *montana* ♀ form
Type Locality: Teton Mountains, Wyoming, July 14, 1934.
Location of Type: W. D. Field Collection, Lawrence, Kansas. (United States National Museum?)
Original Description: 1936, Pomona College Jour. of Ent. Zool., vol. 28, p. 25 (Claremont, Calif.).

mecrida Hewitson, W. C., *Thecla*
Type Locality: Amazon.
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 94, vol. 2, pl. 38, figs. 108, 109 ♂ (London).
Subspecies: *anastomosis* Draudt.

megacles Cramer, Pierre, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description 1780, Papillons exotiques des trois parties du monde, vol. 4, p. 85, pl. 333, figs. E, F (Amsterdam).

megalo McDunnough, James H., *Plebeius aquilo* var .
Type Locality: Mount McLean, Lillooet, British Columbia.
Location of Type: Canadian National Collection, Ottawa, Ontario, no. 2503. (Paratype in the American Museum of Natural History.)
Original Description: 1927 (July), Can. Ent., vol. 59, p. 161 (Orillia, Ont.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 27, no. 452 (Los Angeles, Calif.). (Places *megalo* as a subspecies of *aquilo* Boisduval.)

megamede Prittwitz, O. v., *Thecla*
Type Locality: Corcovado, Rio de Janeiro, Brazil.
Location of Type:
Original Description: 1865, Stettin Ent. Zeit., vol. 26, p. 322 (Stettin).

megarus Godart, Jean B., *Polyommatus*
Type Locality: Brazil.
Location of Type:
Original Description: 1822, Encyclopédie Méthodique, vol. 9, p. 638 (Paris).
Additional Reference: Lathy, Percy I., 1926, Ann. Mag. Nat. Hist., Series 9, vol. 17, p. 46 (London). (Places *megarus* as a synonym of *echion* Linnaeus.)

meinersi Gunder, Jean D., *Strymon melinus* tr. f.
Type Locality: Table Rock, North Carolina.
Location of Type: American Museum of Natural History.
Original Description: 1927 (December), Can. Ent., vol. 59, p. 283, pl. A, figs. 9, 9a (Orillia, Ont.).
Note: A synonym of *melinus* Hübner.

meinersi Field, William D., *Everes comyntas* form
Type Locality: Lawrence, Kansas, April 18, 1936.
Location of Type: W. D. Field Collection. (United States National Museum?) (Paratype in the American Museum of Natural History.)
Original Description: 1938 (October), Jour. Kansas Ent. Soc., vol. 11, no. 4, p. 132 (McPherson, Kansas).

mela Strecker, Herman, *Lycaena*
Type Locality: Colorado ♂; Bastrop, Texas ♂; Chihuahua, Mexico ♀; Muzo, Colombia ♀.
Location of Type: Strecker Collection.
Original Description: 1900 (March), Lepidoptera, Rhopaloceres and Heteroceres, Supplement, no. 3, p. 20 (Reading, Pa.).
Additional Reference: Barnes, William and J. H. McDunnough, 1917 (February), Check list of the Lepidoptera of Boreal America, p. 16, no. 422 (Decatur, Illinois). (Make *mela* a synonym of *cyna* Edwards.)

melba Hewitson, W. C., *Thecla*
Type Locality: Minas Geraes.
Location of Type: British Museum (Natural History).
Original Description: 1877 (January), Illus. of Diurnal Lepidoptera, vol.

1, p. 202, vol. 2, pl. 80, figs. ♀ var. 657, 658 (London). Hewitson makes *melba* a female variety of *badeta* Hewitson.

meleager Druce, Hamilton H., *Thecla*
Type Locality: Surinam.
Location of Type: Druce Collection.
Original Description: 1907 (June). Proc. Zool. Soc. London, p. 618 (London).

melibaeus Butler, A. G., *Panthiades* (not Fabricius) see *meliboeus*
Type Locality:
Location of Type:
Original Description:

meliboeus Fabricius, Johann Christian, *Hesperia rurales*
Type Locality: "In India."
Location of Type:
Original Description: 1793, Entomologica Systematica, vol. 3, p. 271 (Hafniae).
Additional References: Donovan, Edward, 1800, Ins. India, p. 43, pl. 41, fig. 1 (London). Butler, A. G., 1870, Catalogue of Diurnal Lepidoptera Described by Fabricius in the Collection of the British Museum, p. 198 (London). (Gives the name as *Panthiades melibaeus*.) Kirby, W. F. 1871, A Synonomic Catalogue of Diurnal Lepidoptera, p. 384, (London). (Changes the spelling to *melibaeus*.)
Synonyms: *barrensis* Rosa, *eurisides* Hübner.

melidor Druce, Hamilton H., *Thecla*
Type Locality: Río Colorado, Peru, 2500 ft., August.
Location of Type: H. J. Adams Collection.
Original Description: 1909 (September), Trans. Ent. Soc. London, p. 431, pl. 11, fig. 4 ♂ (London).

melimona Wright, William Greenwood, *Lycaena acmon* var.
Type Locality: San Bernardino Mountains, California, June.
Location of Type:
Original Description: 1906, Butterflies of the West Coast, 2nd Edition, p. 226, pl. 29, figs. 382, 382-b, 382-c, 382-cc ♀ (San Bernardino, Calif.)
Note: The date of the species is 1905, from 1st Edition published by the Whitaker and Ray Company, San Francisco, California.
Additional Reference: Grinnell, Fordyce, Jr., 1905 (December), Ent. News, vol. 16, p. 339 (Philadelphia, Pa.). (Makes *melimona* a synonym of *emigdionis* Grinnell.)

melimus Dufrane, Abel, *Thecla* Misspelling of *melinus* Hübner
Type Locality:
Location of Type:
Original Description: 1939 (August), Bull. Ann. Soc. Ent. Belgique, vol. 79, p. 290 (Bruxelles).

melinus Hübner, Jacob, *Rusticus*
Type Locality: Georgia.

Location of Type:

Original Description: 1808, Erste Zuträge zur Sammlung exotischer Schmettlinge p,. 5, nos. 121, 122 (Augsburg). (Nomen nudum.)

Additional References: Hübner, Jacob, 1809–1813, Zuträge zur Sammlung exotischer Schmettlinger, figs. 121, 122 (Augsburg). (Verification of name.) 1818, *op. cit.*, vol. 1, p. 22 (Augsburg). (As *Strymon melinus.*)

Synonmys: *pan* Harris, *silenus* Doubleday, *youngi* Field, *favonius* Boisduval and LeConte, *humuli* Harris, *hyperici* Boisduval and LeConte, *meinersi* Gunder, *melimus* Dufrane, *mellinus* Grote and Robinson.

Subspecies: *sabinus* Felder and Felder, *setonia* McDunnough, *atrofasciata* McDunnough, *clarionensis* Van Duzee, *franki* Field, *grisea* Dufrane, *nigriplaga* Dufrane syn., *pudica* Edwards.

melissa Edwards, William H., *Lycaena*

Type Locality: Colorado.

Location of Type:

Original Description: 1873 (March), Trans. Amer. Ent. Soc., vol. 4, p. 346 (Philadelphia, Pa.).

Synonyms: *inyoensis* Gunder.

Subspecies: *fridayi* Chermock, *lotis* Lintner, *paradoxa* Chermock, *samuelis* Nabokov, *pseudosamuelis* Nabokov.

melleus Druce, Hamilton H., *Thecla*

Type Locality: Río Muzo, Colombia, 2500 ft.

Location of Type: Godman Collection.

Original Description: 1907 (June), Proc. Zool. Soc. London, p. 580, pl. 33, fig. 7 ♂ (London).

mellinus Grote, Augustus R. and Coleman T. Robinson, *Thecla* Misspelling of *melinus* Hübner

Type Locality:

Location of Type:

Original Description: 1867 (July), Trans. Amer. Ent. Soc., vol. 1, p. 173 (Philadelphia, Pa.).

melma Schaus, William, *Thecla*

Type Locality: Guapiles, Costa Rica.

Location of Type:

Original Description: 1913 (September), Proc. Zool. Soc. London, p. 354, pl. 52, fig. 4 ♂ (London).

melzeri Spitz, Robert, *Thecla*

Type Locality: Minas Geraes.

Location of Type: Museu Paulista, Sao Paulo.

Original Description: 1931, Revista de Entomologia, vol. 1, p. 51 (Sao Paulo).

menalcas Cramer, Pierre, *Papilio*

Type Locality: Surinam.

Location of Type:

Original Description: 1779, Papillons exotiques des trois parties du monde, vol. 3, p. 117, pl. 259, figs. A, B (Amsterdam).

Additional Reference: Hewitson, W. C., 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 201 (London). (Hewitson makes *menalcas* Cramer a synonym of *amyntor* Cramer.)

meridionalis Draudt, Max, *Thecla pholeus* form
Type Locality: Brazil and Colombia.
Location of Type:
Original Description: 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 785, pl. 156-b (Stuttgart).

mertila Edwards, William H., *Lycaena*
Type Locality: California.
Location of Type:
Original Description: 1866 (October), Proc. Ent. Soc. Phila., vol. 6, p. 206 (Philadelphia, Pa.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 28, no. 474 (Los Angeles, Calif.). (Places *mertila* as a form of *xerces* Boisduval.)
Synonyms: *barnesi* Gunder, *huguenini* Gunder.

mesca Dyar, Harrison G., *Thecla*
Type Locality: Taboga Island, Panamá.
Location of Type: United States National Museum, no. 15762.
Original Description: 1915, Proc. U. S. Natl. Mus., vol. 47, p. 151 (Washington, D. C.).
Additional Reference: Schaus, William, 1920, Ent. News, vol. 31, p. 176 (Philadelphia, Pa.). (Makes *mesca* a synonym of *serapio* Godman and Salvin.)

metanira Hewitson, W. C., *Thecla*
Type Locality: Amazon (St. Paulo).
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 95, vol. 2, pl. 46, figs. 201, 202 ♂ (London).

meton Cramer, Pierre, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1779, Papillons exotiques des trois parties du monde, vol. 3, p. 15, pl. 201, figs. D, E (Amsterdam).
Synonyms: *augustus* Fabricius, *metus* Hübner.

metus Hübner, Jacob, *Mithras*
Type Locality:
Location of Type:
Original Description: 1819, Verzeichniss bekannter Schmettlinge, p. 79, no. 804 (Augsburg). (Makes a new name and synonym for *meton* Cramer.)

miadora Dyar, Harrison G., *Ipidecla*
Type Locality: Sierra de Guerrero, Mexico, July, 1913.

Location of Type: United States National Museum, no. 18,825 ♀.
Original Description: 1917, Proc. U. S. Natl. Mus., vol. 51, p. 2 (Washington, D. C.).
Additional References: Draudt, Max, 1921, (January), The Macrolepidoptera of the World, vol. 5, p. 824 (insert p. 784) (Stuttgart). (Places *miadora* in Lycaenidae instead of Erycinidae.) Stichel, H., 1930, Lepidopterorum Catalogus (Riodinidae), vol. 26, pt. 41, p. 595 (Berlin).

mildredae Chermock, F. H. *Glaucopsyche lygdamus*
Type Locality: Baddek, Cape Breton Island, Nova Scotia, June 17, 1941.
Location of Type: Author's Collection.
Original Description: 1944 (November), Can. Ent., vol. 76, p. 216 (Guelph, Ont.).

milto Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Chiriquí, Panamá.
Location of Type: Staudinger Collection.
Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 83, vol. 3, pl. 57, figs. 22, 23 ♀ (London).

mimas Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Calobre and Veraguas, Panamá.
Location of Type: British Museum (Natural History).
Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 81, vol. 3, pl. 57, figs. 18, 19 ♂ (London).

mimula Draudt, Max, *Thecla*
Type Locality: Pachitea, Peru.
Location of Type:
Original Description: 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 793, pl. 157-g (Stuttgart).

mincha Kirby, William F., *Plebeius* (not Edwards) Misspelling of *mintha*
Type Locality:
Location of Type:
Original Description: 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 653, no. 329 (London).

minereus Fabricius, Johann Christian, *Papilio*
Type Locality: "America meridionali."
Location of Type:
Original Description: 1787, Mantissa Insectorum, vol. 2, p. 77 (Hafniae).

minijas Hübner, Jacob, *Rusticus adolescens*
Type Locality:
Location of Type:
Original Description: 1809, Sammlung exotischer Schmetterlinge, vol 1, pl. (97) (Augsburg).
Synonyms: *minyas* Hübner, *hagmanni* Röber.

Subspecies: *toxea* Godart (Guatemala), *godartii* Boisduval (Costa Rica), *costaricensis* Draudt syn., *toxana* Boisduval (Brazil?), *brasiliensis* Draudt syn., *peruviana* Lathy (Peru), *obsoleta* Lathy (Bolivia), *superbus* Röber (Bolivia).

minnehaha Scudder, Samuel H., *Agriades*

Type Locality: "Heart River Crossing, Dakotah Terr., about fifty miles west of the Missouri River, June 26."

Location of Type:

Original Description: 1874 (June), Proc. Boston Soc. Nat. Hist., vol. 17, p. 88 (Boston, Mass.).

Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 28, no. 458 (Los Angeles, Calif.). (Places *minnehaha* as a subspecies of *shasta* Edwards.)

minniles Dyar, Harrison G., *Thecla*

Type Locality: Sierra de Guerrero, Mexico, July, 1913.

Location of Type: United States National Museum, no. 19,254.

Original Description: 1917, Proc. U. S. Natl. Mus., vol. 51, p. 3 (Washington, D. C.).

mintha Edwards, William H., *Lycaena*

Type Locality: Nevada (♂, ♀).

Location of Type:

Original Description: 1870 (November), Trans. Amer. Ent. Soc., vol. 3, p. 194 (Philadelphia, Pa.).

Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 27, no. 455 (Los Angeles, Calif.). (Places *mintha* as a synonym of *icarioides* Boisduval with a ?.)

Synonyms: *mincha* Kirby.

minthe Godman, F. D. and O. Salvin, *Thecla*

Type Locality: Milpas, Mexico, elevation 6000 ft.

Location of Type: British Musuem (Natural History).

Original Description: 1887, (August), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 60, vol. 3, pl. 55, figs. 15, 16 ♂ (London).

minyas Hübner, Jacob, *Eumaeus* See *minijas* Hübner

Type Locality:

Location of Type:

Original Description: 1819, Verzeichniss bekannter Schmettlinge, p. 67, no. 643 (Augsburg).

minyia Hewitson, W. C., *Thecla*

Type Locality: Amazon.

Location of Type: British Museum (Natural History).

Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 91, vol. 2, pl. 38, figs. 115, 116 ♂ (London).

mirabelle Barnes, William, *Thecla*

Type Locality: Utah.

Location of Type: Barnes Collection, United States National Museum.
Original Description: 1900 (January), Can. Ent., vol. 32, p. 43 (London, Ont.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 24, no. 376 (Los Angeles, Calif.). (Places *mirabelle* as a synonym of *ilavia* Beutenmüller.)

mirabilis Lathy, Percy I., *Thecla*
Type Locality: Río Pastazza, Eastern Ecudor.
Location of Type: Fournier Collection, Paris.
Original Description: 1930 (June), Trans. Ent. Soc. London, p. 135, pl. 9, fig. 8 (London).

miranda Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Upper Amazons.
Location of Type: British Museum (Natural History).
Original Description: 1887 (October), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 99 (London).

mirma Hewitson, W. C., *Thecla*
Type Locality:
Location of Type: British Museum (Natural History).
Original Description: 1878 (November), Illus. of Diurnal Lepidoptera, vol. 1, p. 212, vol. 2, pl. 85, figs. 719 ♂, 718, 720 ♀ (London).

misenes Cramer, Pierre, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1779, Papillons exotiques des trois parties du monde, vol. 2, p. 31, pl. 117, fig. D (Amsterdam).
Additional References: Godart, Jean B., 1822, Encyclopédie Méthodique, vol. 9, p. 584, no. 96 (Paris). (Places *misenes* in the genus *Erycina.*) Kirby, William F., 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 377, no. 317 (London). (Places *misenes* questionably in the genus *Cupido.*)
Note: This name is ignored by modern authors and its identity is in doubt.

miserabilis Clench, Harry K., *Thecla*
Type Locality: Ricón, Guerrero, Mexico, 2800 ft., October.
Location of Type: British Museum (Natural History).
Original Description: 1946 (July), Entomologist, vol. 79, p. 156 (London).

mishma Hewitson, W. C., *Thecla*
Type Locality: Colombia (Sierra Nevada).
Location of Type: Staudinger Collection.
Original Description: 1878 (November), Illus. of Diurnal Lepidoptera, vol. 1, p. 213, vol. 2, pl. 85, figs. 724, 725 ♂ (London).

missionensis Hovanitz, William, *Plebejus icarioides*
Type Locality: Twin Peaks, San Francisco, California elevation 700 ft.,

April 1, 1934.
Location of Type: California Academy of Sciences, no. 4526.
Original Description: 1937 (October), Pan-Pacific Entomologist, vol. 13, no. 4, p. 187 (San Francisco, Calif.).

modesta Maynard, Charles J., *Lycaena*
Type Locality: Florida.
Location of Type:
Original Description: 1873 (March), American Naturalist, vol. 7, p. 177 (Salem, Mass.).
Additional Reference: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 80, pl. 1, fig. 12 ♀ (New York). (Make *modesta* a subspecies of *columella* Fabricius.)
Synonyms: *ocellifera* Grote.

moesites Draudt, Max, *Thecla* (not Herrich-Schäffer) See *maesites*
Type Locality:
Location of Type:
Original Description: 1920, The Macrolepidoptera of the World, vol. 5, p. 798 (Stuttgart).

mohave McDunnough, James H., *Philotes enoptes* (not Watson and Comstock) See *mojave*
Type Locality:
Location of Type :
Original Description: 1938, Check list, pt. 1, p. 28, no. 467 (Los Angeles, Calif.).

mojave Watson, Frank E. and William P. Comstock, *Philotes enoptes*
Type Locality: Mojave Desert, California.
Location of Type: American Museum of Natural History.
Original Description: 1920, Bull. Amer. Mus. Nat. Hist., vol. 42, p. 455 (New York, N. Y.).
Synonyms *mohave* McDunnough.

molena Jones, E. Dunkinfield, *Thecla*
Type Locality: Castro, Paraná, Brazil.
Location of Type: Jones Collection.
Original Description: 1912, Proc. Zool. Soc. London, p. 899, pl. 97, fig. 9 (London).

moncus Fabricius, Johann Christian, *Papilio plebejus rurales*
Type Locality: "Africa aequinoctiali."
Location of Type: Banksian Collection, British Museum (Natural History).
Original Description: 1781, Species Insectorum, vol. 2, p. 113, no. 492 (Hamburg).
Additional Reference: Butler, A. G., (1869), 1870, Catalogue of Diurnal Lepidoptera Described by Fabricius in the Collection of the British Museum, p. 188, pl. 2, fig. 10 (London). (Butler said that the type was in the Banksian Collection and figured in Jones' Icones, but gave the locality

as Cayenne which has evidently been copied by other authors and accounts for it being listed as an American species.)

monenoptron Dyar, Harrison G., *Ipidecla*
Type Locality: Sierra de Guerrero, Mexico, February, 1913.
Location of Type: United States National Museum, no. 21,198 (1 ♂).
Original Description: 1919, Proc. U. S. Natl. Mus., vol. 54, p. 336 (Washington, D .C.).
Additional References: Draudt, Max, 1921 (January), The Macrolepidoptera of the World, vol. 5, p. 824 (insert p. 784, pl. 144-n) (Stuttgart). (Places *monenoptron* in Lycaenidae instead of Erycinidae.) Stichel, H., 1930, Lepidopterorum Catalogus (Riodinidae), vol. 26, pt. 41, p. 595 (Berlin).

monica Reakirt, Tyron, *Lycaena*
Type Locality: "California."
Location of Type: Strecker Collection (2 ♂).
Original Description: 1866 (June), Proc. Acad. Nat. Sci., Phila., p. 244 (Philadelphia, Pa.).
Additional Reference: Strecker, Herman, 1900 (March), Lepidoptera-Rhopaloceres and Heteroceres, Supplement no. 3, p. 20 (Reading, Pa.). (Makes *monica* a synonym of *Hesperia cnejus* Fabricius from the East Indies.)
Synonyms: *monila* Edwards.

monica Hewitson, W. C. *Thecla*
Type Locality: Venezuela.
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 80, vol. 2, pl. 32, figs. 39, 40 ♀ (London).
Synonyms: *augustinus* Butler and Druce, *augustula* Kirby.

monila Edwards, William H., *Lycaena* (not Reakirt) Misspelling of *monica* Reakirt
Type Locality:
Location of Type:
Original Description: 1872, Synopsis of North American Butterflies, p. 34, no. 18 (Philadelphia, Pa.).

montana Field, William D., *Lycaena editha*
Type Locality: Broadwater County, Montana, July 30, 1930.
Location of Type: W. D. Field Collection, Lawrence, Kansas. (United States National Museum?)
Original Description: 1936 (May), Ent. News, vol. 47, no. 5, p. 122 (Philadelphia, Pa.).
Synonyms: *meadi* Field.

montanensis Watson, Frank E. and William P. Comstock, *Strymon acadica*
Type Locality: Montana.
Location of Type: American Museum of Natural History.
Original Description: 1920 (December), Bull. Amer. Mus. Nat. Hist., vol. 42, art. 10, p. 451 (New York, N. Y.)

montanus Gunder, Jean D., *Plebeius monticola* tr. f.
Type Locality: Cajon Pass, San Bernardino County, California, May 14, 1922.
Location of Type: American Museum of Natural History.
Original Description: 1929 (December), Bull. Brooklyn Ent. Soc., vol. 24, p. 326, pl. 31, fig. 3 (Brooklyn, N. Y.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 28, no. 461 (Los Angeles, Calif.). (Places *montanus* as an aberration of *monticola* Clémence.)

monticola Clémence, Victor L., *Rusticus acmon*
Type Locality: Pasadena, California, 3000 ft., May 9.
Location of Type: Clémence Collection.
Original Description: 1909 (January), Can. Ent., vol. 41, p. 38 (Guelph, Ont.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 28, no. 461 (Los Angeles, Calif.). (Places *Plebeius monticola* as a species.)
Synonyms: *angelus* Gunder, *malcolmi* Gunder, *montanus* Gunder, *pallida* Gunder.

montis Blackmore, E. H., *Plebeius icarioides*
Type Locality: Mount McLean, near Lillooet, British Columbia, July 15, 1919.
Location of Type: Canadian National Collection, Ottowa, Ontario.
Original Description: 1923, Can. Ent., vol. 55, p. 99 (Orillia, Ont.).

mopsus Hübner, Jacob, *Rusticus*
Type Locality: Georgia.
Location of Type:
Original Description: 1808, Erste Zuträge zur Sammlung exotischer Schmettlinge, p. 6, nos. 135, 136 (Augsburg). (Nomen nudum.)
Additional References: Hübner, Jacob, 1809–1813, Zuträge zur Sammlung exotischer Schmettlinge, figs. 135, 136 (Augsburg). (Verification of name.); 1818, *op. cit.*, vol. 1, p. 24 (Augsburg). (As *Chrysophanus mopsus.*) Dyar, Harrison, G., 1902, Bull. U. S. Natl. Mus., no. 52, p. 40 (Washington, D. C.). (Makes *mopsus* a synonym of *titus* Fabricius.)

moroensis Sternitzky, R. F. *Plebejus icarioides*
Type Locality: Moro Beach, San Luis Obispo County, California, June 27, 1929.
Location of Type: California Academy of Sciences, San Francisco, California.
Original Description: 1930 (April), 1931 (July), Pan-Pacific Entomologist, vol. 7, p. 93 (San Francisco, Calif.).

mossii Edwards, Henry, *Thecla irus* var.
Type Locality: Esquimalt, Vancouver Island, British Columbia.
Location of Type: American Museum of Natural History (1 ♂).
Original Description: 1881 (April), Papilio, vol. 1, p. 54 (New York).
Additional Reference: Cook, John H., 1908 (February), Can. Ent., vol.

40, p. 40, pl. 2, figs. 5 ♀, 6 ♂ (London, Ont.).
Note: We consider *mosii* to be a distinct species.

moza Staudinger, Otto, *Cupido*
Type Locality: Cocapata and Huallatani, Bolivia.
Location of Type:
Original Description: 1894, Deutsche Ent. Zeit., (Iris), vol. 7, p. 79, pl. 2, fig. 5 (Dresden).

muatta Hewitson, W. C., *Thecla*
Type Locality: Brazil.
Location of Type: British Museum (Natural History).
Original Description: 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 206, vol. 2, pl. 82, figs. 687, 688 (London).

Muattina Schaus, William, *Thecla*
Type Locality: Castro, Paraná, Brazil.
Location of Type: United States National Museum, no. 5940.
Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 415 (Washington, D. C.).

muela Dyar, Harrison, G., *Thecla*
Type Locality: Cotahuasi, Peru, 9000 ft., October, 1911.
Location of Type: United States National Museum, no. 15,624 (2 cotypes).
Original Description: 1913, Proc. U. S. Natl. Mus., vol. 45, p. 637 (Washington, D. C.).

muiri Edwards, Henry, *Thecla*
Type Locality: Mendocino County, California.
Location of Type: American Museum of Natural History (1 ♂, 1 ♀).
Original Description: 1881 (April), Papilio, vol. 1, p. 53 (New York).

mulsus Druce, Hamilton H., *Thecla*
Type Locality: Tapajos, Amazonas, Brazil.
Location of Type: Godman Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 598, pl. 35, fig. 10 ♂ (London).

mulucha Hewitson, W. C., *Thecla*
Type Locality: Venezuela.
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 89, vol. 2, pl. 38, fig. 117 ♂ (London).
Additional References: Hewitson, W. C., 1874 (December), *op. cit.*, vol. 1, p. 159, vol. 2, pl. 62, fig. 428 ♀. Godman, F. D. and O. Salvin, 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 95 (London). (Make reference to Central and South American localities.)
Synonyms: *crossoea* Hewitson, *crossaea* Draudt, *invisus* Butler and Druce.

munatia Hewitson, W. C., *Thecla*
Type Locality: Guatemala.
Location of Type: Staudinger Collection.
Original Description: 1878 (November), Illus. of Diurnal Lepidoptera, vol. 1, p. 211, vol. 2, pl. 84, figs. 716, 717 ♂ (London).
Additional Reference: Godman, F. D. and O. Salvin, 1887 (August), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 58 (London). (Make *munatia* a synonym of *ericeta* Hewitson.)

munditia Druce, Hamilton H., *Thecla*
Type Locality: Bartica, British Guiana.
Location of Type: Druce Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 586, pl. 34, figs. 10 ♂ 11 ♀ (London).

murex Druce, Hamilton H., *Thecla*
Type Locality: Río Grande, Brazil.
Location of Type: Druce Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 585, pl. 34, fig. 6 ♂ (London).
Additional Reference: Draudt, Max, 1920 (January), The Macrolepidoptera of the World, vol. 5, p. 770, pl. 152-h (Stuttgart), (Places *murex* as a subspecies of *mycon* Godman and Salvin.)

muridosca Dyar, Harrison G., *Thecla*
Type Locality: Jalapa, Mexico.
Location of Type: United States National Museum, no. 21,201.
Original Description: 1919, Proc. U. S. Natl. Mus., vol. 54, p. 337 (Washington, D. C.).

muskoka Watson, Frank E., and William P. Comstock, *Strymon acadica* ab.
Type Locality: Gravenhurst, Muskoka District, Ontario, Canada, July 27, 1918. (Collection H. S. Parrish.)
Location of Type: American Museum of Natural History.
Original Description: 1920 (December), Bull. Amer. Mus. Nat. Hist., vol. 42, art. 10, p. 450 (New York, N. Y.).

mutina Hewitson, W. C., *Thecla*
Type Locality: Amazon.
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 94, vol. 2, pl. 38, figs. 113, 114 ♂ (London).

mycon Godman, F. D. and O. Salvin, *Thecla*
Type Locality: San Gerónimo, Guatemala.
Location of Type: British Museum (Natural History).
Original Description: 1887 (June), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 46, vol. 3, pl. 53, figs. 20, 21 ♂, 22 ♀ (London).
Subspecies: *murex* Druce.

myron Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Cache, Costa Rica.
Location of Type: British Museum (Natural History).
Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 82 (London).

myrsina Hewitson, W. C., *Thecla*
Type Locality: Nicaragua (Chontales).
Location of Type: British Museum (Natural History).
Original Description: 1874 (December), Illus. of Diurnal Lepidoptera, vol. 1, p. 184, vol. 2, pl. 73, figs. 571, 572 ♂ (London).
Additional Reference: Godman, F. D. and O. Salvin, 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 67, vol. 3, pl. 56, fig. 10 ♂ (London). Chontales.

myrtea Hewitson, W. C., *Thelca*
Type Locality: Amazon.
Location of Type: British Museum (Natural History).
Original Description: 1869 (April), Illus. of Diurnal Lepidoptera, vol. 1, p. 93, vol. 2, pl. 38, fig. 112 ♂ (London).

myrtillus Cramer, Pierre, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1784, Papillons exotiques des trois parties du monde, vol. 4, p. 178, pl. 380, figs. B, C. (Amsterdam).
Additional Reference: Kirby, W. F., 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 384, (London). (Makes *myrtillus* a synonym of *palegon* Cramer.)
Synonyms: *mytillus* Godman and Salvin.

myrtusa Hewitson, W. C., *Thecla*
Type Locality: Amazon.
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol 1, p. 95, vol. 2, pl. 38, fig. 111 ♀ (London).

mytillus Godman, F. D. and O. Salvin, *Thecla*
Type Locality:
Location of Type:
Original Description: 1887 (May), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 37 (London). This is a misspelling of *myrtillus* Cramer.

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SPIDER GYNANDROMORPHS AND INTERSEXES

B. J. Kaston
Central Connecticut State College
New Britain, Connecticut

While cases of gynandromorphism and intersexuality occasionally occur among the Arthropoda in general, they are exceedingly rare in spiders. Nevertheless, after eye defects (Kaston, in press) anomalies associated with the genitalia are next most frequently reported. The first record of such an anomaly to appear in the literature was that of a specimen of the micryphantid, *Oedothorax fuscus* (Blackwall), reported (sub *Erigone*) by Kulczynski in 1886. This was a case of gynandromorphism in which one side of the body showed all male characteristics, while the other side showed all female. The specimen was again described and discussed in the excellent review articles by Rabaud & Millot (1933) and Bonnet (1934). Other more recent workers to consider Kulczynski's and similar isolated cases are Exline (1938), Holm (1941), and Knülle (1954).

Rabaud and Millot were the first to consider an abnormal specimen as an intersexual individual. This was a specimen of *Argiope bruennichi* (Scopoli) which, rather than showing definite male characters in some parts of the body and female in other parts, displayed an intermediate condition. These authors also suggested that in some of the other cases in the literature the anomalous appearance of the specimen may be due to a mixture of *both* gynandry and intersexuality.

During the past few years there have come to my attention a number of specimens showing anomalies of the genitalia and of other sex characters. Of these, four individuals can be considered as gynandromorphs and six as intersexes, and these ten

are described below. Still other types of genitalia deformities are being described elsewhere (Kaston, in press). The author wishes to thank Dr. W. J. Gertsch of the American Museum of Natural History and Dr. H. K. Wallace of the University of Florida for the loan of specimens in their care. The illustrations were all prepared by my wife.

Description of Cases

Coelotes atropos (Walckenaer)

The spider was collected by Dr. H. Homann near a small village about 12 kilometers north of Braunschweig in Germany, on May 1, 1944. The specimen was kept alive in the laboratory for about three weeks during which time it laid about 35 eggs. Homann found that the egg sac appeared completely normal, but the eggs did not develop, presumably because fertilization had not taken place.

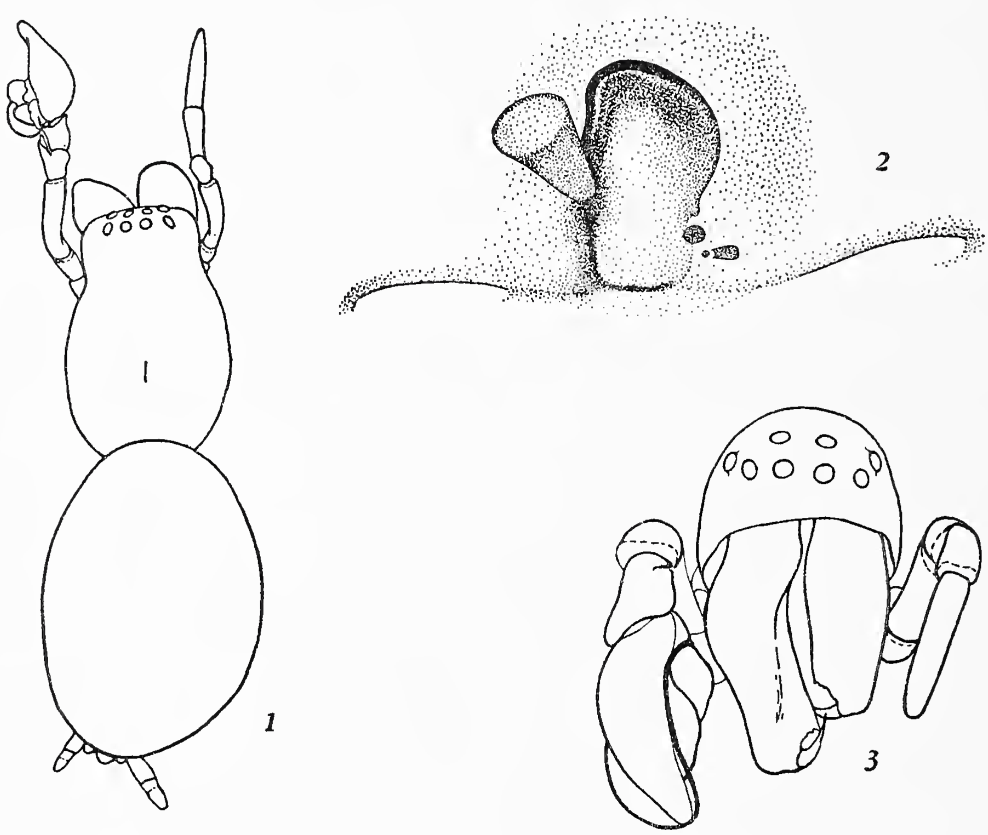


Fig. 1. Dorsal aspect of the gynandromorph *Coelotes atropos*.
Fig. 2. Epigynum of same specimen.
Fig. 3. Face view of gynandromorph *Dictyna coloradensis*.

The specimen (figure 1) is immediately recognizable as abnormal in that only the right palp is that of a female, while the left

palp has a palpal organ as in a male. Closer observation reveals the following additional details: the right chelicera is geniculate and more strongly developed than the left; the abdomen is very strongly asymmetrical, with the right side larger than the left and more hairy; on the venter the right side is darker than the left. Moreover, the epigynum shows the left half only imperfectly formed (figure 2), and the right posterior spinneret is somewhat longer than the left. The legs on the left side are more slender and slightly longer than those on the right side. They average about 1.1 times as long as their respective mates. The two sides differ with respect to leg spination, particularly on tibia and metatarsus. For the right leg I the tibia prolateral arrangement is 1–0–0, the ventral is 2–2–2; the metatarsus prolateral is 0–0–1, and ventral is 2–2–2. For the left leg I the tibia has no prolateral spines at all and the ventral arrangement is 0–0–2; the metatarsus shows prolateral 0–0–1, and ventral 2–0–2. The second legs also show differences between left and right.

The total length of the specimen (cephalothorax plus abdomen) is 9 mm., and that of the carapace is 4.2 mm. According to Locket & Millidge in "British Spiders", males are from 7 to 9 mm., and females from 9 to 12 mm. in length.[1] Thus this specimen is intermediate, and there hardly seems any question that this is a typical case of lateral gynandromorphism.

Dictyna coloradensis Chamberlin

The spider was collected in the Wasatch Mountains of Utah on June 16, 1942 by Wilton Ivie. This specimen shows a normal epigynum and an abdomen which is perfectly symmetrical in shape and color pattern. On the anterior half of the body, however, one sees differences between left and right sides. The left palp, chelicera, and endite are typical for a female, while the right palp, chelicera and endite are exactly like those in a male. The palpal organ and the tibial apophysis are both perfectly normal. The clypeus is somewhat higher on the right side, and the chelicera, as is usual for males of this genus, shows the typical elongation, is concave in front, is bowed outward and bears

[1] These measurements are based on specimens belonging to *atropos s. str.*, and, as Locket & Millidge show, the continental araneologists have been including *terrestris* (Wider) as a synonym of *atropos*. Specimens of *terrestris* average much larger in size.

the lateral keel (figure 3). The legs on the right (i.e., male) side are longer than those on the left; leg I on the right being 3.12 times the length of the carapace while that on the left is only 2.53 times this length. Moreover, the legs on the left (i.e., female) side show more pronounced dark annulations at the ends of the segments than do those on the right (or male) side.

This specimen then is a mosaic gynandromorph with the male tissue occupying the anterior right quarter of the animal, the rest being female tissue.

Xysticus transversatus (Walckenaer)

The spider was collected near South New Hope, Pennsylvania on May 15, 1953 by Wilton Ivie. As in the preceding case (of *Dictyna coloradensis*) the abdomen is symmetrical as to shape and color pattern, the epigynum is normal, and only the right anterior quarter of the body exhibits the male characteristics, although there are some imperfections.

The right palp is equipped with a palpal organ (partly dis-

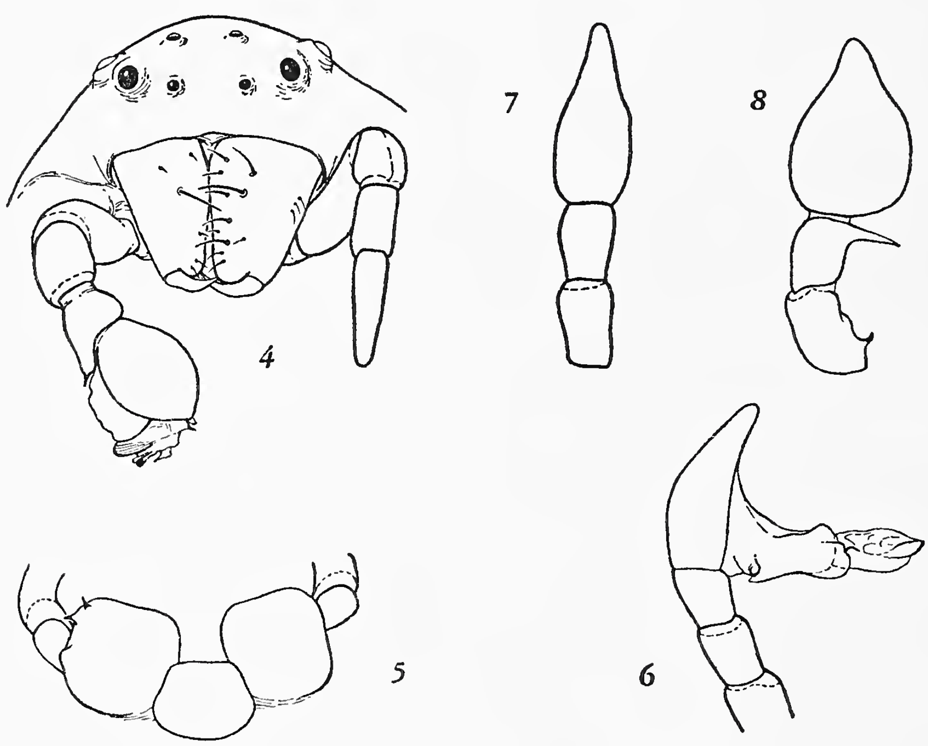


Fig. 4. Face view of gynandromorph *Xysticus transversatus*.
Fig. 5. Labium and endites of gynandromorph *Neoantistea radula*.
Fig. 6. Ectal aspect of right palp, same specimen.
Fig. 7. Dorsal aspect of same palp.
Fig. 8. Dorsal aspect of the right palp of a normal male *N. radula*.

tended), while the left is simple as in a female. The right chelicera is more slender than the left, and on its prolateral face has fewer spines, of which only one is large and none are along the lateral edge (figure 4). The left chelicera has more spines, of which six are large and three are along the lateral edge. The spacing of the eyes is that of a female, with the anterior medians separated by three times the diameter of one. The color pattern of the carapace is basically female with the right half only slightly darker (a male trait). However, this male half has fewer spines, and the spines are shorter and more slender than on the female half. The legs likewise show the female color pattern and are the same on both sides, but the two sides differ with respect to length and with respect to spination. For example, legs I and II on the right side are each 4 times as long as the carapace, while on the left side they are only 3.16 times as long. The spination is given below:

	LEFT LEG	RIGHT LEG
Patella I	prolateral 0	prolateral 1
Patella II	prolateral 0	prolateral 1
Tibia I	prolateral 0	prolateral 2-2-2
	ventral 2-2-2-2-2-2	ventral 2-2-2-2
Tibia II	prolateral 0	prolateral 2-2-2
	ventral 2-2-2-2-2	ventral 2-2-2-2
Metatarsus I	prolateral 1-1-1	prolateral 1-1-1
	ventral 2-2-2-2	ventral 2-2-2
Metatarsus II	prolateral 1-1-1	prolateral 1-1-1
	ventral 2-2-2-2-2	ventral 2-2-2

Similar differences in leg length and spination were found by Anderson (1961) in his gynandromorph of the same species. However, his specimen was a typical lateral gynandromorph in which the two sides differed in color pattern too. My specimen is a mosaic, with the male tissue occupying, apparently, less than the anterior right quarter of the animal.

Neoantistea radula (Emerton)

The spider was collected at West Ossipee, New Hampshire on August 1, 1936 by Stanley B. Mulaik. It has the same size and general appearance of a female, and the epigynum is normal.

The legs of both sides are similar in length. Also, the bristle-bearing ridges on the ventral side of the femora are the same on both left and right and are female in type. The chelicerae are the same, somewhat less robust than in the female, in fact about as in the male. The left pedipalp is of the normal female type, but the right pedipalp is of the male type, though imperfect as can be seen from figures 6 and 7. The endite, or basal segment of the right pedipalp, shows the spurs characteristic of the male (figure 5) though they are somewhat smaller than in a normal specimen. These are lacking in the left endite. The palpal organ is developed on the right palp, but is distended; the cymbium is narrower than the normal, the patella lacks the short

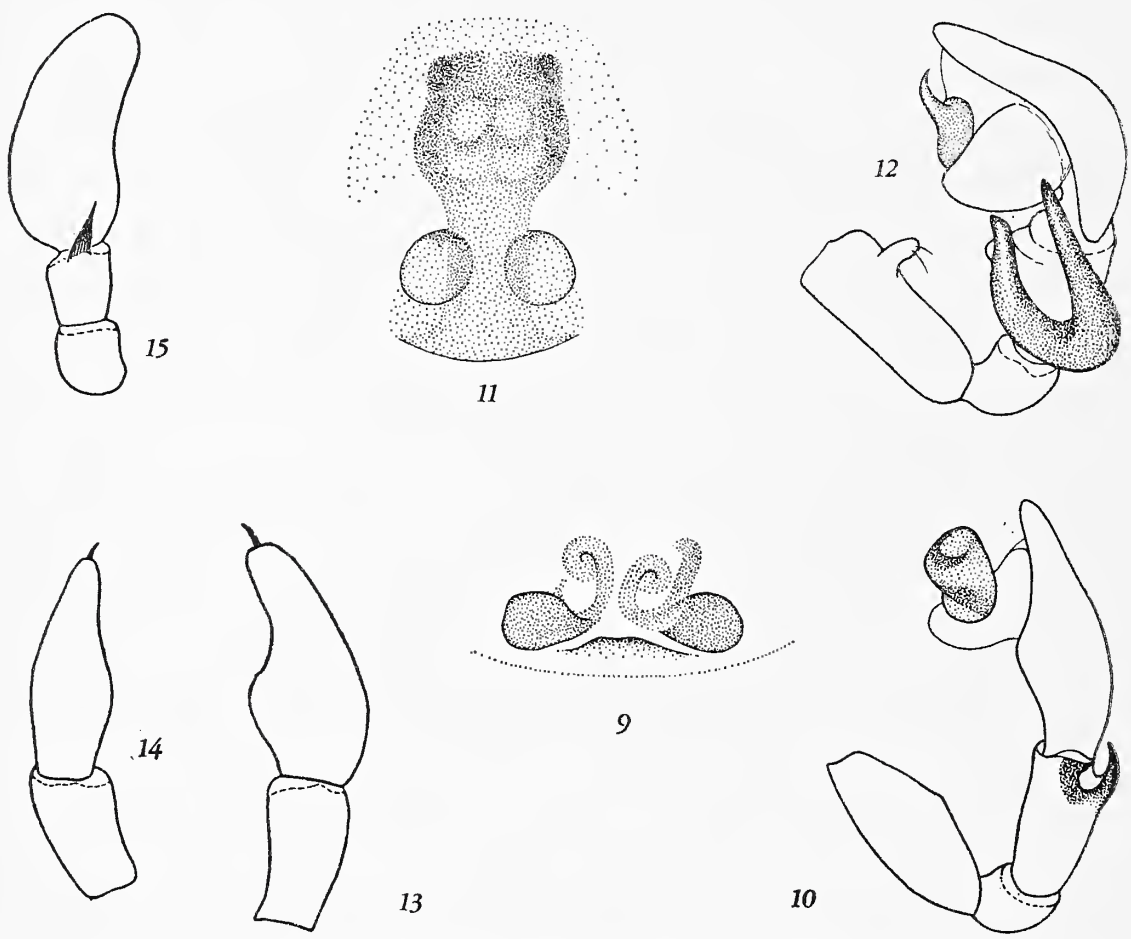


Fig. 9. Epigynum of intersexual *Scotinella pelvicolens.*
Fig. 10. Left palp of same specimen, ectal aspect.
Fig. 11. Epigynum of normal female of *S. pelvicolens.*
Fig. 12. Left palp of normal male of *S. pelvicolens.*
Fig. 13. Left palp of intersexual *Lycosa lenta.*
Fig. 14. Right palp of intersexual *L. tumuqua.*
Fig. 15. Right palp of intersexual *Metaphidippus flavipedes.*

spur normally present in the male, and the tibia lacks the long thin apophysis. (Compare figures 7 and 8.) One might conjecture that the spider had once lost the three distalmost segments of the right pedipalp and that the present structure is an imperfectly regenerated one such as those described in my paper on genital deformities (in press).

This specimen, then, would appear to be a mosaic gynandromorph, with male tissue restricted to only the right pedipalp.

Scotinella pelvicolens (Chamberlin & Gertsch)

The specimen was collected at Warm Springs, Idaho on August 31, 1941 by J. C. Chamberlin and D. E. Fox. An epigynum is present, and on each side of the body the palp is developed as in the male, so that at first glance I mistook this for a gynandromorph of the transverse type (with anterior half male and posterior half female). Closer examination, however, revealed that neither the epigynum nor the palpi are normally developed. In the case of the epigynum the posterior portion shows the seminal receptacles clearly, but the anterior area is reduced considerably as can be seen by comparing figures 9 and 11. For each of the palpi one can see that the bulb of the palpal organ is abnormally distended. Also, the tibial apophysis shows both prongs considerably reduced in size, and the femoral apophysis is reduced to only a very slight elevation, (figures 10 and 12).

In this species the two sexes normally show differences in the depth of pigmentation and in the proportionate size of cephalothorax and abdomen. The males are slightly browner than females and possess a shiny scutum on the dorsum of the abdomen. The length of the cephalothorax in males averages 0.7 mm., in females 0.8 mm.; the length of the abdomen in males averages 0.83 mm., in females 1.1 mm. The cephalothorax of my anomalous specimen measures 0.74 mm., and its abdomen is 1.05 mm. Thus it can be seen that it exhibits size and proportions between that of the normal male and a normal female. Its carapace is brownish resembling that of males, but the abdomen is grayer and without the scutum, so that it appears more like that of a female.

It seems obvious that this specimen is an intersex very much like those described by Holm (1941) for *Pardosa amentata* (Clerck) (sub *Lycosa saccata*).

Lycosa lenta Hentz

The spider was collected near Lakeland, Florida on June 27, 1935 by H. K. Wallace. The specimen is perfectly symmetrical, and bears a normal appearing epigynum. Both palpi, however, resemble those borne by males in the penultimate instar. The palps are equally developed, with expanded cymbium, but without alveolar cavity or palpal organ (figure 13). It seems reasonable to suppose that the specimen is an example of intersexuality, with a preponderance of femaleness. This case very much resemples the case reported by Holm (1941) in several lycosids, especially *Pardosa pullata* (Clerck) (sub *Lycosa*).

Lycosa tumuqua Wallace

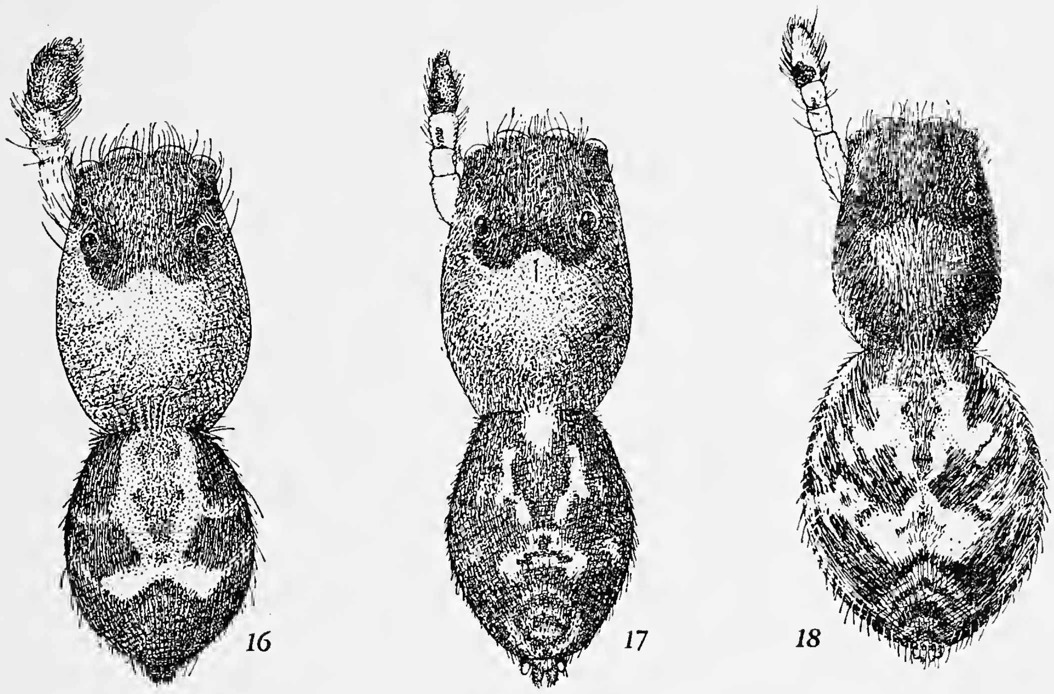
The spider was collected in Alachua County, Florida on February 16, 1936 by H. K. Wallace. As in the preceding case, the specimen is perfectly symmetrical and bears a normal appearing epigynum, but both palpi appear as they ordinarily do in males of the antepenultimate instar (figure 14). This too, is undoubtedly an example of intersexuality, with a predominance of femaleness. This case very much resembles the case reported by Holm (1941) in *Pardosa prativaga* (L. Koch) (sub *Lycosa riparia sphagnicola*).

Habrocestum pulex (Hentz)

There are two specimens, both collected in southern New York, and both showing the same type of anomaly. One was taken near Spring Valley by Annette Bacon on July 5, 1943, the other near Suffern by W. J. Gertsch on May 27, 1939.

In this species there is sexual dimorphism with respect to the proportionate size of cephalothorax and abdomen, and with respect to pattern and degree of pigmentation. There is more contrast in the pattern of the male. Also, the male has a black venter, not yellow as in the female, and has more black on the segments of the legs and pedipalps. For example, the female has some black at the base of the palpal tarsus, but the male has black extending to the apex. It is interesting to note, as I have already pointed out (1948), that immature males and even teneral adult males have the general appearance of the female, the pigmentation process not being complete until sometime after the final ecdysis.

The anomalous specimen from Spring Valley can easily be taken for a male at first glance because of its abdomen being small, and because of the male pattern of pigmentation on the leg and palpal segments, carapace, dorsum and venter. However, the palpal tarsus, though black from base to apex, is not enlarged to form a cymbium. The epigynum appears normal. A comparison of figures 16, 17, and 18 shows the intermediate



16 17 18

Fig. 16. Dorsal aspect of "normal male" *Habrocestum pulex*.
Fig. 17. "Intersex" of the same species.
Fig. 18. Normal female of the same species.

appearance of this individual.

The specimen from Suffern is similar to the preceding, but in this case the abdomen is slightly wider, so that it is more like that of a normal female.

Metaphidippus flavipedes (Peckham)

The specimen was collected at Orillia, Ontario, Canada by C. H. Curran (date not given). The general appearance is that of a female, and the epigynum is normal. Unfortunately the left palp is missing. The right palp shows an enlarged cymbium but no alveolar cavity, and of course no palpal organ. In this respect it is like the condition in the penultimate instar. However, the tibial apophysis is as well developed (figure 15) as in a mature male! This specimen appears to be another case of intersexuality with a preponderance of femaleness.

DISCUSSION

It is generally agreed by geneticists that in *Drosophila melanogaster* a gynandromorph of some kind is produced in every 2000 to 3000 flies. When, for example, an X-chromosome of a dividing 2X-chromosome zygote lags behind, and remains in the center of the spindle in the first cleavage (eventually to become lost in the cytoplasm) a gynandromorph is produced. One half of the body will then contain male tissue (of which each cell contains XO) and the other half female tissue (of which each cell contains XX). Similar irregularities in later divisions produce smaller portions of male tissue in an individual predominantly female. Just as in *Drosophila,* in spiders too it is the male that is heterogametic, but only 16 species of the 141 for which the chormosome situation has been studied are of the type where a single X-chromosome is present in each somatic cell. All of the others exhibit the X_1X_2-X_3O, or else the X_1X_2O type, in which the somatic cells of males contain, respectively, three or two fewer chromosomes than do the somatic cells of females. Obviously the production of a gynandromorph in the manner known to produce them in *Drosophila* (i.e., from genetically determined females) would involve a loss of two or three chromosomes (not just one) during a mitosis. Now, if among spiders generally the proportion of species having a multiple sex chromosome situation is anywhere near as high as is the case for those species definitely known, then we may have, at least in part, an explanation for the rarity of gynandromorphism in these animals. It would seem reasonable to suppose that the likelihood of two or three chromosome lagging behind on a mitotic sipndle is surely not as great as the possibility that a single chromosome might do so.

Based on his finding two sperms in some mature fertilized eggs of spiders Hackman (1952) suggested another explanation for the origin of gynandry. This supposes that one of the two sperms carried no X-chromosome (and hence was male determining) while the other sperm was female determining; and that further, one of the sperms fertilized the polar body, and that this latter later became a part of the developing embryo.

Intersexuality in spiders is more difficult to explain. Nothing is known about their chromosome constitution to compare with that in the *Drosophila* intersexes so well known from the classic work of Bridges on "genic balance". In Holm's specimens it

would appear that the intersexual individuals were originally males in whom the testes did not develop properly, because of the spiders being parasitized internally by nematodes, e.g., *Mermis*. The variation in the degree of intersexuality seen in his five cases of lycosids he considered as most probably due to the differences in the ages of the spiders at the time the parasites entered their bodies. In those spiders which had been parasitized early in their lives there had been a longer time for the testicular development to be interfered with, and hence a greater degree of intersexuality resulted, with a greater tendency toward femaleness.

In the investigations of Rabaud and Millot the intersexual *Argiope bruennichi* (Scopoli) was found to have its testes reduced to only a fourth or fifth of the size in normal males, but no nematode parasite was found. That the mere reduction, or absence, of testes does not always result in intersexuality was shown by these same investigators. They reported a male *Araneus bituberculatus* (Walckenaer) (sub *dromedarius*) which appeared perfectly normal with respect to body size and palpal organs, etc., yet which, upon study of the internal organs, proved to be completely lacking in testes! In addition, it need hardly be added that cases of parasitism have been noted unaccompanied by intersexuality.

Machado (1951) reported an intersexual ochyroceratid, *Speleocera vilhenai* Machado, which appeared to be parasitized by a basidiomycetous fungus.

Of those cases previously reported to be gynandromorphs, Rabaud and Millot suggested that Falconer's *Oedothorax retusus* (Westring) exhibited intersexuality as well as gynandromorphism. Likewise, for the *Diaea dorsata* (Fabricius) of Bertkau, and the *Drassodes lapidosus* (Walckenaer) of Jackson, Holm indicated that possibly intersexuality could, at least to some degree, account for the anomalous appearance of the specimens.

SUMMARY

Bonnet (1934) formulated a scheme of classification for the 17 then known cases of sexual anomalies, all of which were rated by him as gynandromorphs. He considered four categories as follows: typical lateral, with one half of the body male and the other half female; lateral crossed; transverse; and partial. For

the lateral crossed category he had one case, a *Micrargus herbidgradus* (Blackwall), which had been reported (sub *Lophomma*) by Hull to be male on the right side of the cephalothorax but female on the right side of the abdomen. Concerning this case Holm suggested that there had probably been an error of interpretation, and that the specimen is actually a typical lateral gynandromorph. Of the transverse gynandromorphs, all show the anterior half male and the posterior half (abdomen) female. As Bonnet pointed out, if there were to be a gynandromorph with the anterior half female and the posterior half male the abdomen would be lacking an epigynum. Consequently these individuals would go unrecognized, for they simply would be taken for immature females. Some cases of aberrations were so inadequately described that Bonnet did not feel he could assign them to a proper category, but I believe that these probably fit into his partial, or mosaic, gynandromorphism, where a relatively small part of the body is of one sex and the large majority of the cells are of the other sex. In the list that follows I have used Bonnet's basic scheme, with modifications and additions, and have placed the 47 presently known cases.

I. Cases of lateral gynandromorphism

Oedothorax fuscus (Blackwall) of Kulczynski 1886 (sub *Erigone*)
Porrhomma pallidum Jackson of Jackson 1906 (sub *oblongum*)
Lepthyphantes pallidus (O. P.-Cambridge) of Jackson 1909
Micrargus herbidgradus (Blackwall) of Hull 1914 (sub *Lophomma*)
Tmeticus graminicola (Sundevall) of Deichmann 1920 (sub *Gongylidium*)
Pardosa pullata (Clerck) of Braendegaard 1925 (sub *Lycosa*)
Philaeus chrysops (Poda) of Balogh 1936
Neoantistea agilis (Keyserling) of Exline 1938
Oedothorax retusus (Westring) of Holm 1941
Oxyopes heterophthalmus Latreille of Hadjissarantos 1951
Troxochrus scabriculus (Westring) of Hackman 1952
Xysticus transversatus (Walckenaer) of Anderson 1961
Coelotes atropos (Walckenaer) of present author

II. Cases of partial or mosaic gynandromorphism

Hilaira excisa (O. P.-Cambridge) of O. P.-Cambridge 1902
Drassodes neglectus (Keyserling) of Emerton 1907 (sub *Drassus saccatus*)
linyphiid near *Bathyphantes* sp. of Exline 1938
Metaphidippus galathea (Walckenaer) of Muma 1943 (sub *ornatus*)
Lasiargus hirsutus (Menge) of Denis 1947
Lephthyphantes tenuis (Blackwall) of Denis 1949
Erigone vagans spinosa O. P.-Cambridge of Knülle 1954
Xysticus transversatus (Walckenaer) of present author
Dictyna coloradensis Chamberlin of present author
Neoantistea radula (Emerton) of present author

III. Inadequately described but probably belong with group II above

Tetragnatha montana Simon of Strand 1900 (sub *solandri*)
Agroeca proxima (O. P.-Cambridge) of O. P.-Cambridge 1913
Hilaira excisa (O. P.-Cambridge) of Hull 1918
Micryphantes sp. of Kolosvary 1935

IV. Cases of transverse gynandromorphism

A member of the *Pardosa monticola* group[2] of Bertkau 1889 (sub *Lycosa morosa*)
Maso sundevalli (Westring) of Falconer 1910
Agroeca pullata Thorell of Spassky 1914 (sub *chrysea*)
Pardosa sternalis (Thorell) of Exline 1938

V. Cases of transverse gynandromorphism but mixed with intersexuality

Diaea dorsata (Fabricius) of Bertkau 1888
Oedothorax retusus (Westring) of Falconer 1910
Drassodes lapidosus (Walckenaer) of Jackson 1924

VI. Cases of intersexuality

Argiope bruennichi (Scopoli) of Rabaud & Millot 1933
Pardosa palustris (Linnaeus) of Holm 1941 (sub *Lycosa tarsalis*)
Pardosa pullata (Clerck) of Holm 1941 (sub *Lycosa*)

[2] In the opinion of Holm (1941).

Pardosa amentata (Clerck) of Holm 1941 (sub *Lycosa saccata*) [2 examples]
Pardosa prativaga (L. Koch) of Holm 1941 (sub *Lycosa riparia sphagnicola*)
Speocera vilhenai Machado of Machado 1951
Lycosa lenta Hentz of present author
Lycosa tumuqua Wallace of present author
Scotinella pelvicolens (Chamberlin & Gertsch) of present author
Habrocestum pulex (Hentz) of present author [2 examples]
Metaphidippus flavipedes (Peckham) of present author

Readers desiring full bibliographic citations for the above cases reported from the earlier literature are referred to the papers of Bonnet (1934) and Holm (1941).

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AN ANNOTATED LIST OF THE LYCAENIDAE (LEPIDOPTERA: RHOPALOCERA) OF THE WESTERN HEMISPHERE

BY WILLIAM PHILLIPS COMSTOCK AND EDGAR IRVING HUNTINGTON

[Continued]

nais Kirby, W. F., Lycaena (not Edwards) *Nomen nudum*
Type locality:
Location of Type:
Original Description: 1871, A Synonymic Catalogue of Diurnal Lepidoptera, p. 653, no. 42 (London).
Additional Reference: Scudder, Samuel H., 1876 (May), Bull. Buffalo Soc. Nat. Sci., vol. 3, p. 129 (Buffalo, N. Y.).

nana Felder, Cajetan and Rudolf Felder, *Pseudolycaena*
Type Locality: New Granada, Bogotá.
Location of Type:
Original Description: 1864–1867, Reise der Osterreichischen Fregatte "Novara" um die Erde, vol. 2, p. 250, pl. 31, figs. 21, 22 ♂ (Wien).

nannidion Burmeister, H., *Thecla*
Type Locality: Corrientes Province, Argentina.
Location of Type:
Original Description: 1878, Desc. Physique République Argentina, vol. 5, Lepidoptera, pt. 1, p. 231, Atlas pl. 8, fig. 10 (Buenos Aires).

narbal Stoll, Caspar, *Papilio*
Type Locality: Surinam.
Location of Type:
Original Description: 1790, Papillons exotiques des trois parties du monde, Supplement, p. 168, pl. 38, figs. 6, 6F (Amsterdam).

nautes Cramer, Pierre, *Papilio*
Type Locality: Surniam.
Location of Type:
Original Description: 1779, Papillons exotiques des trois parties du monde, vol. 3, p. 70, pl. 233, figs. F, G (Amsterdam).
Synonyms: *nautus* Hübner.

nautus Hübner, Jacob, *Mithras* (not Cramer) Misspelling of *nautes* Cramer
Type Locality:
Location of Type:

Original Description: 1819, Verzeichniss bekannter Schmettlinge, p. 79, no. 802 (Augsburg).

nebis Godart, Jean B., *Polyommatus*
Type Locality: Brazil.
Location of Type:
Original Description: 1822, Encyclopédie Méthodique, vol. 9, p. 636 (Paris).
Additional Reference: Druce, H. H., 1907, Proc. Zool. Soc. London, p. 568 (London). (Did not recognize the species).

neglecta Edwards, William H., *Lycaena*
Type Locality: Massachusetts, New York, Wisconsin, Lake Winnepeg.
Location of Type:
Original Description: 1862 (February), Proc. Acad. Nat. Scit. Phila., p. 56 (Philadelphia, Pa.).
Additional Reference: McDunnough, J. H., 1938, Check List, pt. 1, p. 28, no. 475 (Los Angeles, Calif.). (Places *neglecta* as a summer form of *pseudargiolus* Boisduval and LeConte.)
Synonyms: *deutargiolus* Scudder.

neglecta-major Tutt, J. W., *Celastrina argiolus* summer form
Type Locality: Eastern United States.
Location of Type:
Original Description: 1908, Nat. Hist. Brit. Lepid., vol. 9, p. 407 (London).
Additional References: Edwards, W. H., 1884, The Butterflies of North America, vol. 2, p. 5, pl. 2, figs. 8, 9 (Boston, Mass.). (Stated it was the form of lying in May.) McDunnough, J. H., 1938, Check list, pt. 1, p. 28, no. 475 (Los Angeles, Calif.). (Lists *neglecta-major* as a summer form of *pseudargiolus* Boisduval and LeConte.)

nelsoni Boisduval, Jean A., *Thecla*
Type Locality: California.
Location of Type: United States National Museum?
Original Description: 1869, Ann. Soc. Ent. Belgique, vol. 12, p. 43 (Bruxelles).
Additional Reference: Oberthür, Charles, 1913 (October), Etudes de Lepidopterologie Comparee, fasc. 9, pt. 1, p. 42, pl. 238, fig. 1954 (Rennes).
Subspecies: *exoleta* Edwards.

neon Capronnier, J. B., *Thecla Nomen nudum*
Type Locality: Botafogo, Brazil.
Location of Type:
Original Description: 1874, Ann. Soc. Ent. Belgique, vol. 17, p. 15 (Bruxelles).

neoperplexa Barnes, William and F. H. Benjamin, *Callophrys sherdiani* race
Type Locality: Eureka, Utah.
Location of Type: Barnes Collection, United States National Museum. (Paratype in the American Museum of Natural History.)
Original Description: 1923 (March), Contributions to the natural history of the Lepidoptera of North America, vol. 5, no. 2, p. 67 (Decatur, Illinois).

neora Hewitson, W. C., *Thecla*
Type Locality: Guatemala.
Location of Type: British Museum (Natural History).
Original Description: 1867, Illus. of Diurnal Lepidoptera, vol. 1, p. 90, vol. 2, pl. 38, fig. 110 ♀ (London).
Additional Reference: Godman, F. D. and O. Salvin, 1887 (May), Biologia Centrali-Americana, Insecto, Lepidoptera-Rhopalocera, vol. 2, p. 24, vol. 3, pl. 50, figs. 16, 17 ♂, 18 ♀ (London).

nephon Westwood, John Obadiah, *Thecla* (not Hübner) Misspelling of *niphon* Hübner
Type Locality: Florida.
Location of Type:
Original Description: 1852 (April), Genera of Diurnal Lepidoptera, vol. 2, p. 486 (London).

nepia, Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Polochic Valley, Guatemala.
Location of Type: British Museum (Natural History).
Original Description: 1887 (May), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 16, vol. 3, pl. 50, figs. 19, 20 ♂ (London).
Additional References: Draudt, Max, 1919, The Macrolepidoptera of the World, vol. 5, p. 748 (Stuttgart). (Makes *nepia* a synonym of *theocritus* Fabricius.) Goodson, F. W., 1945 (November), Entomologist, vol. 78, p. 170 (London). (Makes *nepia* a synonym of *theocritus* Fabricius.)

nestos Boisduval, Jean A., *Lycaena*
Type Locality: Oregon, July.
Location of Type: United States National Museum?
Original Description: 1869, Ann. Soc. Ent. Belgique, vol. 12, p. 50 (Bruxelles).
Additional References: Oberthür, Charles, 1913 (October), Etudes de Lepidopterologic Comparee, fasc. 9, pt. 1, p. 43, pl. 239, figs. 2074 ♂, 2075 ♀ (Rennes). McDonnough, J. H., 1938, Check list, pt. 1, p. 27, no. 452 (Los Angeles, Calif.). (Places *nestos* as a synonym of *aquilo podarce* C. and R. Felder.)

netesca Draudt, Max, *Thecla*
Type Locality: Guiana to South Peru.
Location of Type:

Original Description: 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 795, pl. 158-a (Stuttgart).

neui Rummel, Charles, *Heodes hypophlaeas* ab.
Type Locality: Hillside, New Jersey.
Location of Type: Rummel Collection (Newark Museum).
Original Description: 1928, Bull. Brooklyn Ent. Soc., vol. 23, p. 268 (Brooklyn, N. Y.).

neurona Skinner, Henry, *Lycaena*
Type Locality: Doble, San Bernardino County, California, August.
Location of Type: Academy of Natural Sciences, Philadelphia, Pennsylvania.
Original Description: 1892 (January), Ent. News, vol. 13, p. 15 (Philadelphia, Pa.).

nicetus Felder, Cajetan and Rudolf Felder, *Thecla*
Type Locality: Venezuela.
Location of Type:
Original Description: 1864–1867, Reise des Osterreichischen Fregatte "Novara" um die Erde, vol. 2, p. 263, pl. 32, fig. 23 (Wien).
Subspecies: *ochracea* Lathy.

nig Strecker, Herman, *Lycaena lucia* ab. ♀
Type Locality: Virginia.
Location of Type:
Original Description: 1878, Butterflies and Moths of North America. A Complete Synonymical Catalog, p. 95, no. 136 (Reading, Pa.).
Additional Reference: Barnes, William and F. H. Benjamin, 1926 (March), Bull. Southern Calif. Acad. Sci., vol. 25, p. 20 (Los Angeles, Calif.). (List *nig* as a "♂" form of *pseudargiolus* Boisduval and LeConte.)

nigra Edwards, W. H., *Lycaena pseudargiolus* winter form *violacea* dimorphic ♂.
Type Locality: Kanawha River, West Virginia.
Location of Type:
Original Description: 1884 (June), The Butterflies of North America, vol. 2, p. 315, pl. 50, fig. 7 ♂ (Boston, Mass.).
Additional References: Edwards, W. H., 1869 (May), The Butterflies of North America, vol. 1, p. 149, pl. 49, fig. 4 ♀ var. (Boston, Mass.). (Edwards here first refers to "upper side uniform blackish-brown" as a ♀ var., not naming it.) McDunnough, J. H., 1938, Check list, pt. 1, p. 28, no. 475 (Los Angeles, Calif.). (Places *nigra* as a synonym of *pseudargiolus* form ♂ *nig* Strecker.)

nigra Lathy, Percy I., *Thecla eurytulus*
Type Locality: Tucuman, Argentina, June 9, 1922 (1 ♂).

Location of Type: Fournier Collection, Paris.
Original Description: 1926, Ann. Mag. Nat. Hist., Series 9, vol. 17, p. 46 (London).
Additional Reference: Comstock, W. P. and E. I. Huntington, 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 87 (New York).

nigrescens Fletcher, James, *Lycaena pseudargiolus* var.
Type Locality: Kaslo, British Colombia.
Location of Type: United States National Museum.
Original Description: 1903, Trans. Royal Soc. Canada, Section 4, p. 213, figs. (Ottawa, Ont.).
Additional References: Fletcher, James, 1904 (May), Can. Ent., vol. 36, p. 127, pl. (London, Ont.). McDonnough, J. H., 1938, Check list, pt. 1, p. 29, no. 475 (Los Angeles, Calif.). (Places *nigrescens* as a subspecies of *pseudargiolus* Boisduval and LeConte.)
Note: The name is a homonym of *Lycaena nigrescens* Dubois, A., 1867, Arch. Cosmol., p. 259, pl. 12, figs. 1, 2 (Luchon).
Synonyms: *quesnelli* Cockle, *maculata-suffusa* Cockle.

nigriplaga Dufrane, Abel, *Thecla melimus grisea* ab.
Type Locality: Trujillo, Peru.
Location of Type:
Original Description: 1939 (August), Bull. Ann. Soc. Ent. Belgique, vol. 79, p. 290 (Bruxelles).

nigroflavus Goeze, J. A. E., *Papilio*
Type Locality:
Location of Type:
Original Description: 1779, Ent. Beyträge, vol. 3, 1, p. 119, no. 49 (Leipsig).
Additional Reference: Druce, H. H., 1907, Proc. Zool. Soc. London, p. 568 (London). (Could not recognize the species.)

nigroinita Gunder, Jean D., *Callipsyche behrii* ab. ♂
Type Locality: Mammoth Camp, Mono County, California, August 5, 1921.
Location of Type: American Museum of Natural History.
Original Description: 1924 (May), Ent. News, vol. 35, p. 154, pl. II, fig. A (Philadelphia, Pa.).

ninus Edwards, William H., *Thecla*
Type Locality: Colorado.
Location of Type:
Original Description: 1871 (March), Trans. Amer. Ent. Soc., vol. 3, p. 270 (Philadelphia, Pa.).
Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 25, no. 396 (Los Angeles, Calif.). (Places *ninus* as a synonym of *spinetorum* Hewitson.)

nipha Morris, John G., *Thecla* (not Hübner) Misspelling of *niphon* Hübner
Type Locality: North America.
Location of Type:
Original Description: 1860 (May), Catalogue of the Described Lepidoptera of North America, p. 12 (Washington, D. C.). (Smithsonian Misc. Collections.)

niphon Hübner, Jacob, *Licus*
Type Locality: Florida.
Location of Type:
Original Description: 1823, Zuträge zur Sammlung exotischer Schmettlinge, vol. 2, p. 7, pl. (36), figs. 203, 204 (Augsburg).
Synonyms: *nephon* Westwood, *nipha* Morris.
Subspecies: *clarki* Freeman.

nipona Hewitson, W. C., *Thecla*
Type Locality: Brazil.
Location of Type: British Museum (Natural History).
Original Description: 1877 (January), Illus. of Diurnal Lepidoptera, vol. 1, p. 204, vol. 2, pl. 81, figs. 673, 674 ♂, 675 ♀ (London).
Additional Reference: Druce, H. H., 1907 (June), Proc. Zool. Soc. London, p. 623 (London). (Makes *nipona* a synonym of *azia* Hewitson.).

nippia Dyar, Harrison, G., *Thecla*
Type Locality: Sierra de Guerrero, Mexico, January, 1911.
Location of Type: United States National Musem, no. 21,201.
Original Description: 1919, Proc. U. S. Natl. Mus., vol. 54, p. 337 (Washington, D. C.).

nisaee Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Bugaba, Panamá.
Location of Type: British Museum (Natural History).
Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 67, vol. 3, pl. 56, figs. 8, 9 ♂ (London).

nitetis Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Jalapa and mountains of Oaxaca, Mexico.
Location of Type: British Museum (Natural History).
Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 74, vol. 3, pl. 57, figs. 1, 2 ♂, 3 ♀ (London).

nitor Druce, Hamilton H., *Thecla*
Type Locality: Ega, Amazonas, Brazil.
Location of Type: Godman Collection.
Original Description: 1907 (June), Proc. Zool. Soc., London, p. 585, pl. 34, fig. 5 ♂ (London).

nittanyensis Chermock, F. H., *Glaucopsyche lygdamus*
Type Locality: Bear Meadows, near State College, Pennsylvania, May 13, 1940.
Location of Type: Author's Collection.
Original Description: 1944 (November), Can. Ent., vol. 76, p. 216 (Guelph, Ont.).

nivalis Boisduval, Jean A., *Polyommatus*
Type Locality: California.
Location of Type: United States National Museum?
Original Description: 1869, Ann. Soc. Ent. Belgique, vol. 12, p. 44 (Bruxelles).
Additional Reference: Oberthür, Charles, 1913 (October), Etudes de Lepidopterologic Comparee, fasc. 9, pt. 1, p. 42, pl. 238, figs. 1955 ♂, 1956 ♀ (Rennes).
Synonyms: *ianthe* Edwards.
Subspecies: *browni* dos Passos.

nivepunctata Druce, Hamilton H., *Thecla*
Type Locality: British Guiana and Surinam.
Location of Type: Druce Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 592, pl. 35, fig. 1 ♂ (London).

nivium Boisduval, Jean A., *Lycaena*
Type Locality: Oregon.
Location of Type: United States National Museum?
Original Description: 1869, Ann. Soc. Ent. Belgique, vol. 12, p. 47 (Bruxelles).
Additional References: Oberthür, Charles, 1913 (October), Etudes de Lepidopterologic Comparee, fasc. 9, pt. 1, p. 42, pl. 238, figs. 1963 ♂, 1964 ♀ (Rennes). Strecker, Herman, 1878, Butterflies and Moths of North America. A Complete Synonymical Catalog, p. 94 (Reading, Pa.). (Places *nivium* as a synonym of *shasta* Edwards.)

nobilis Herrich-Schäffer, G. A. W., *Thecla*
Type Locality: Surinam.
Location of Type:
Original Description: 1853, Sammlung aussereuropäischer Schmetterlinge, p. 55, pl. 14, figs. 55, 56 (Regensburg).
Note: *nobilis* is now considered to be the female of *ganymedes* Cramer and a synonym.
Synonyms: *bimaculata* Möschler.

noëli Comstock, W. P. and E. I. Huntington, *Hemiargus ammon*
Type Locality: St. Marc, Haiti, March 30–April 2, 1922.
Location of Type: American Museum of Natural History.

Original Description: 1943 (December), Ann. New York Acad. Sci., vol. 45, p. 99, pl. 1, fig. 23 ♂ (New York).

nora Jones, E. Dukinfield, *Thecla*
Type Locality: Castro, Paraná, Brazil.
Location of Type: Jones Collection.
Original Description: 1912, Proc. Zool. Soc. London, p. 899, pl. 97, fig. 8 (London).

norax Godman, F. D. and O. Salvin, *Thecla*
Type Locality: Polochic Valley, Guatemala.
Location of Type: British Museum (Natural History).
Original Description: 1887 (August), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 59, vol. 3, pl. 55, figs. 17, 18 ♂ (London).

normahal Schaus, William, *Thecla*
Type Locality: Peru.
Location of Type: United States National Museum, no. 5927.
Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 410 (Washington, D. C.).
Additional Reference: Draudt, Max, 1920 (February), The Macrolepidoptera of the World, vol. 5, p. 805, pl. 159-e (Stuttgart).

nortia Godman, F. D. and O. Salvin, *Thecla*
Type Locality: San Geronimo and San Isidro, Guatemala.
Location of Type: British Museum (Natural History).
Original Description: 1887 (September), Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2, p. 76, vol. 3, pl. 57, figs. 11, 12 ♂, 13 ♀ (London).

nota Druce, Hamilton H., *Thecla*
Type Locality: San Sebastián, Colombia.
Location of Type: Godman Collection.
Original Description: 1907 (June), Proc. Zool. Soc. London, p. 592, pl. 34, fig. 7 ♂ (London).

nova-scotiae McDunnough, James H., *Feniseca tarquinius* var.
Type Locality: S. Milford, Nova Scotia, July 2, 1934.
Location of Type: Canadian National Collection, Ottawa, Ontario, no. 3995. (Paratype in the American Museum of Natural History.)
Original Description: 1935 (October), Can. Ent., vol. 67, no. 10, p. 211 (Orillia, Ont.).

nubes Druce, Hamilton H., *Thecla*
Type Locality: Tobago Island (Trinidad), B. W. I. April.
Location of Type: Hope Collection, Oxford.

Original Description: 1907 (June), Proc. Zool. Soc. London, p. 625 (London).

Additional Reference: 1912, Longstaff, George B., Butterfly Hunting in Many Lands, p. 330, pl. 3, figs. 3, 4, 5 (London). (Figures male and female.)

nubila Comstock, John Adams, *Tharsalea arota* race

Type Locality: Griffith Park, Los Angeles, California.

Location of Type: Southwest Museum, Los Angeles, California. (Paratype in the American Museum of Natural History.)

Original Description: 1926 (March), Bull. Southern Calif. Acad. Sci., vol. 25, pt. 1, p. 34 (Los Angeles, Calif.).

Additional Reference: Comstock, John Adams, 1927, Butterflies of California, p. 171, pl. 51, figs. 2, 5 ♂, 3 ♀ (Los Angeles, Calif.).

nubilum Druce, Hamilton H., *Thecla*

Type Locality: Castro, Paraná, Brazil.

Location of Type: Druce Collection.

Original Description: 1907 (June), Proc. Zool. Soc. London, p. 612 (London).

nugar Schaus, William, *Thecla*

Type Locality: Jalapa, Mexico.

Location of Type: United States National Museum, no. 5924.

Original Description: 1902, Proc. U. S. Natl. Mus., vol. 24, p. 408 (Washington, D. C.).

Additional Reference: Draudt, Max, 1920 (January), The Macrolepidoptera of the World, vol. 5, p. 776, pl. 155-b (Stuttgart).

numen Druce, Hamilton H., *Thecla*

Type Locality: Roraima, British Guiana.

Location of Type: Godman Collection.

Original Description: 1907 (June), Proc. Zool. Soc. London, p. 574, pl. 32, figs. 4 ♂, 5 ♀ (London).

numerius Stoll, Caspar, *Papilio*

Type Locality: Surinam.

Location of Type:

Original Description: 1790, Papillons exotiques des trois parties du monde, Supplement, p. 169, pl. 38, figs. 7, 7 G (Amsterdam).

nunenmacheri Strand, Embrik, *Cyaniris ladon* ab.

Type Locality: Eldorado County, California, June 25–28, 1913; Lake County, Oregon, May 24, 1913.

Location of Type:

Original Description: 1915 (1914), Archiv fur Natürgeschichte, 80th year, Abteilung A, Heft 11, p. 159 (Berlin).

Additional Reference: McDunnough, J. H., 1938, Check list, pt. 1, p. 29, no. 475 (Los Angeles, Calif.). (Places *nunenmacheri* as an aberration of *pseudargiolus echo* Edwards.)

nyagora Boisduval, Jean A., *Lycaena*
Type Locality: Mexico.
Location of Type:
Original Description: 1870, Considérations sur des Lépidoptères Envoyes du Guatemala á M. de l'Orza, p. 17 (Rennes).
Note: Draudt, Max, 1921, The Macrolepidoptera of the World, vol. 5, p. 819, considers *nyagora* an insignificant form of *isola Reakirt*.

FORMS AND ARRANGEMENTS OF SCALES IN SPECIES OF *COLIAS* (LEPIDOPTERA: PIERIDAE)

By P. H. H. GRAY
DIGBY, NOVA SCOTIA, CANADA

During an examination of the wings of males of *Colias eurytheme* Bdv. it was noted that the scales of the upper layer, both orange and yellow, are different in dimensions, shapes and colors from those of the under layer; this is especially clear in respect of the areas where the orange color predominates. The scales of the upper layer of the fore wing, between vein M_1 and the inner edge, exclusive of those lying adjacent to the veins, those of the cell-end spot, and those in the brown border, have entire (plain, not indented) distal ends. The scales of the under layer are partly visible wherever some of the upper scales have been slightly dislodged or removed; they are light yellow and have indented (crown) distal ends.

The arrangement of these scales on the wing can easily be seen under a 10× ocular and 16 mm. objective, with incident light from a 60 watt lamp about 8–10 inches above the wing, the base of which is directed towards the lamp; the indentations of the crown scales will be cast in shadow onto the backs of the long scales adjacent to and forward of them.

The upper layer of scales can be partially removed to show the under layer *in situ* on the membrane, by placing a detached wing within a folded piece of typewriter carbon paper and applying gentle pressure in a light metal vise. The writer places the carbon paper containing the wing inside a folded piece of Bristol board, or similar stiff card, that within folded blotting paper, and the whole between two small pieces of Masonite, smooth side inwards; only experience can decide how much pressure to apply. The wax paper will, of course, remove scales from both surfaces of the wing, so that there will be three specimens suitable for mounting between glass microscope slides.

Removal of the upper layer of scales will reveal the lower layer sufficiently to allow measurement of the scales in their sockets, and the distances between the sockets. The scales are seen to be inserted in alternate sockets, the upper layer of plain scales hav-

ing been removed from the sockets between those occupied by the shorter crown scales. The sockets are 32 μ apart. It has been found that the distance between the mid-longitudinal lines of the upper scales is 64 μ, thus pointing up the fact that their pedicels occupied the alternate sockets 64 μ apart. The mean width of both kinds of scales is 56 μ.

The same arrangement of scales was found on the fore wings of *C. philodice* Gdt.; the upper layer of scales, however, is yellow on all parts of the wing, with only crown distal ends.

The diagrammatic sketch in Fig. 1 shows a hypothetically even and uniform arrangement of the scales; the two figures on the left represent scales of *eurytheme,* the remainder, those of *philodice.*

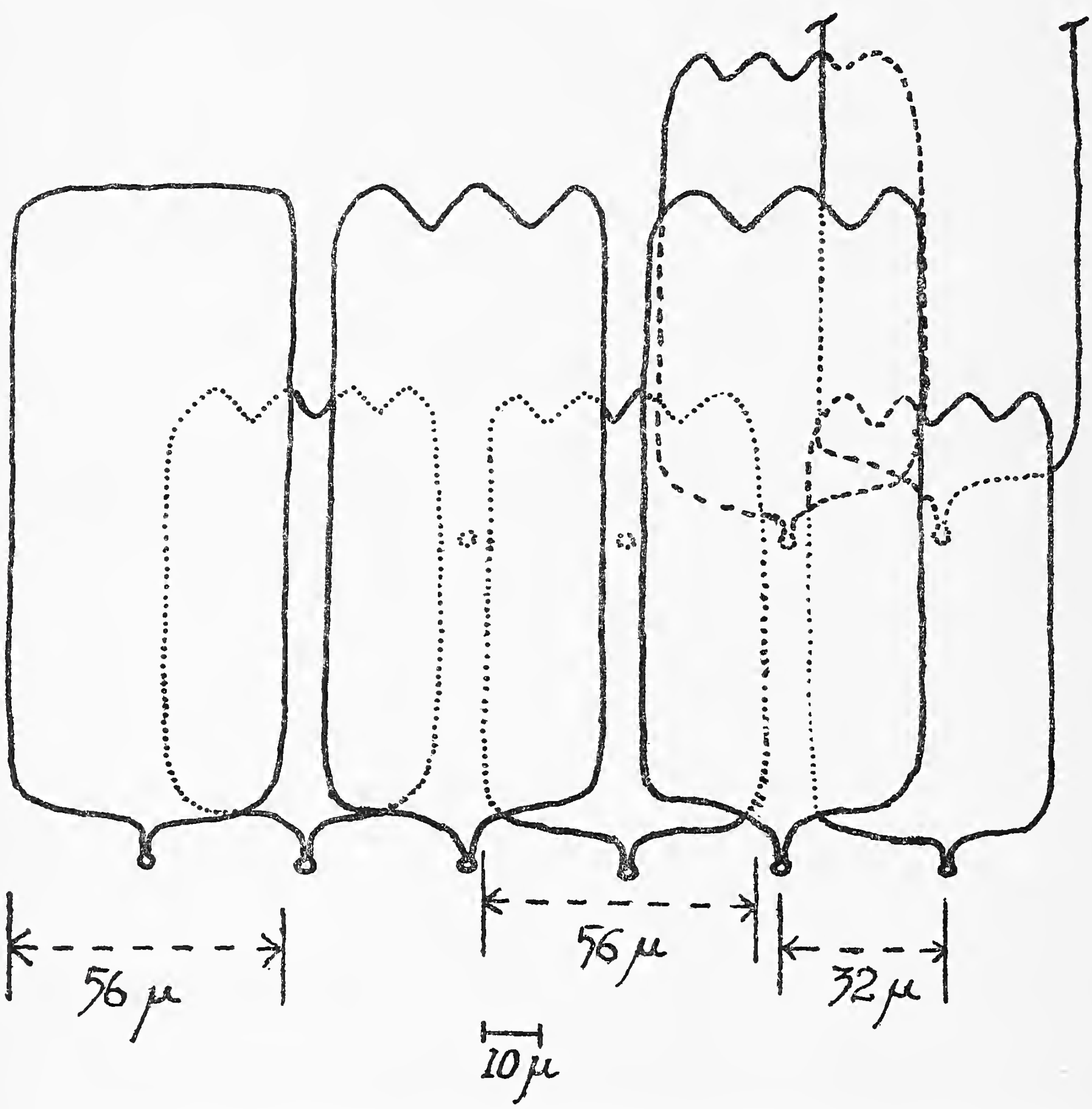


FIG. 1. Diagrammatic sketch of arrangement and forms of scales on the upper side of wings of *Colias eurytheme* and *C. philodice.*

A SYNOPSIS OF THE GENUS NYCTEOLA FROM NORTH AMERICA, INCLUDING A NEW SPECIES FROM ARIZONA (LEPIDOPTERA: NOCTUIDAE)

BY FREDERICK H. RINDGE

DEPT. OF ENTOMOLOGY, THE AMERICAN MUSEUM OF NATURAL HISTORY

The North American species of the genus *Nycteola* Hübner have been discussed, and their genitalia figured, by McDunnough (1943, pp. 60–62, figs. 1–3) and Fletcher (1959, pp. 51–52, figs. 1–5). The former illustrated the aedeagus of *frigidana* (Walker), *columbiana* (H. Edwards), and *cinereana* Neumoegen and Dyar. Fletcher, in addition to presenting a more complete synonymy, distributional notes and the present location of the types, figured the aedeagus of *scriptana* (Walker) and the female genitalia of all four of these species.

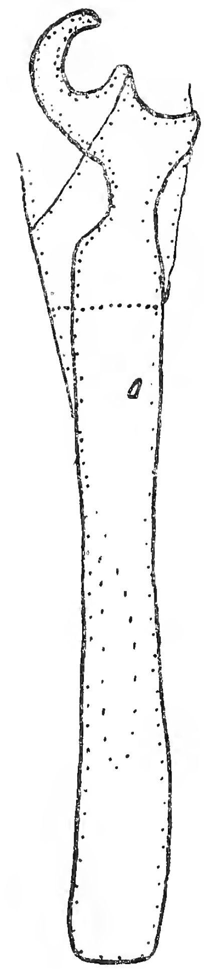
Fletcher also noted the presence of a fifth North American species in this genus; a lack of males prevented his naming it. Since the appearance of his paper additional material of both sexes has come to hand, and so I take pleasure in naming this species after Mr. D. S. Fletcher of the Department of Entomology, the British Museum (Natural History).

Nycteola fletcheri, new species

A species closely similar to *cinereana* Neumoegen and Dyar, having grayish white secondaries, and best distinguished by genitalic characters.

UPPER SURFACE OF FOREWINGS gray, with geminate, black, wavy t. a. and t. p. lines, the former more or less running at right angles to costa, the latter S-shaped below cell; median area dark gray in cell, except for brown or reddish brown, slightly lunate, discal spot, below cell pale gray or grayish brown; base of wing with black streaks along anterior margin of anal vein and of radial vein; basal line geminate, indistinctly represented; outer portion of wing with incompletely represented, dark gray or grayish black s. t. line; terminal line black, narrow; fringe concolorous with wing. Hind wings shiny white, overlain with grayish or grayish brown scales, and without maculation.

UNDER SURFACE OF PRIMARIES unicolorous grayish brown, with white



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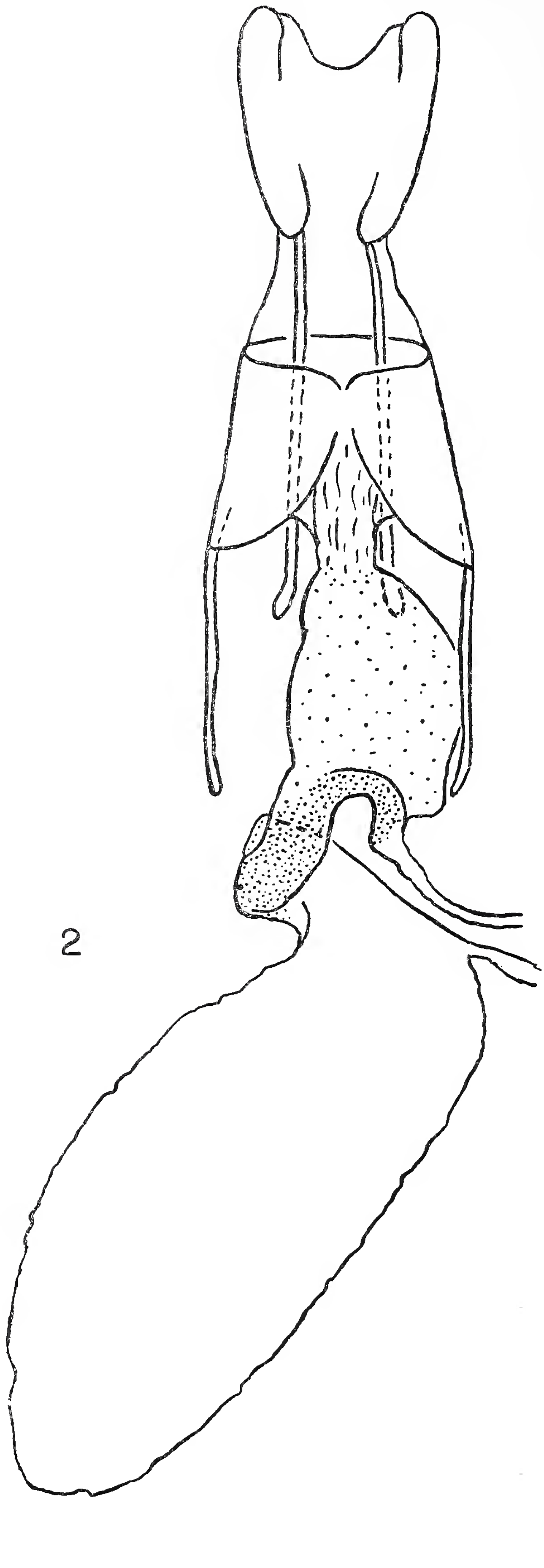

2

scaling on costa; secondaries shiny white, overlain with grayish or grayish brown scales.

LENGTH OF FOREWING Males, 12–13 (holotype) mm.; females, 12–13 (allotype) mm.

MALE GENITALIA Similar to the other species in the genus, being quite complex. The aedeagus (fig. 1) furnishes the best recognition character, as it is slender, terminating in a broad, sickle-shaped protuberance with a basal tooth, and having a very small cornutus.

FEMALE GENITALIA Ductus bursae swollen from narrow ostial region, somewhat globular; ductus seminalis arising anteriorly on right side or near midline; corpus bursae arising from left side of ductus bursae, being more heavily sclerotized than the latter, extending anterolaterally, sharply curved dorsally and going posterolaterally, the larger, more membranous portion of corpus bursae curving anteriory and being elongate to globular in outline. (fig. 2).

TYPES Holotype, male, Southwestern Research Station of the American Museum of Natural History, 5 miles west of Portal, Cochise County, Arizona, elevation 5400 feet, March 11, 1961 (M. A. Cazier); allotype, female, same data, July 26, 1957 (M. Statham). Paratypes, same data as types, one male, February 16, 1961 (M. A. Cazier), and 10 females, various dates in May, July, August and September (W. J. Gertsch, M. Statham, C. W. Kirkwood). All specimens in the collection of the American Museum of Natural History.

Fletcher states that a specimen of this species in the collection of the British Museum (Natural History) is labelled Santa Monica, California.

This species is closely allied to *cinereana*. The sickle-shaped termination of the male aedeagus, and the recurved base of the corpus bursae will distinguish *fletcheri* from the previously described species.

The five North American species of *Nycteola* are quite similar to one another in size, maculation, and color. It is perhaps safest, when in doubt as to the correct identity of a specimen, to make a genitalic dissection. Fortunately the genitalia of both sexes have good characters so that the different species may be distinguished by these organs. The following keys are given as an aid in identification.

KEY TO SPECIES

BASED ON MALE GENITALIA

1. Aedeagus without curved, apical spinose process .... *frigidana* (Walker)
   Aedeagus with curved, apical spinose process 2
2. Apical spinose process arising from a more or less rectangular sclerotized piece, extending at angle to aedeagus 3

Apical spinose process sickle-shaped, recurving toward longitudinal axis of aedeagus 4

3. Apical spinose process with transverse piece at right angle to aedeagus, and slightly more than twice as long as basal sclerotized piece .... *scriptana* (Walker)

Apical spinose process with curved transverse piece at 45° angle to aedeagus, and not much longer than basal sclerotized piece .... *cinereana* Neumoegen and Dyar

4. Sickle-shaped apical piece slender, elongate, gently curved .... *columbiana* (H. Edwards)

Sickle-shaped apical piece short, thick, sharply recurved, and with prominent basal tooth .... *fletcheri* Rindge

BASED ON FEMALE GENITALIA

1. Posterior sclerotized portion of corpus bursae very long and slender, much exceeding the length of the ductus bursae .... *frigidana* (Walker)

Posterior sclerotized portion of corpus bursae shorter than length of ductus bursae 2

2. Ductus seminalis arising on left side 3

Ductus seminalis arising on right side 4

3. Ductus seminalis arising from broad base on sclerotized ductus bursae .... *scriptana* (Walker)

Ductus seminalis arising from membranous area between sclerotized ductus bursae and main body of corpus bursae .... *cinereana* Neumoegen and Dyar

4. More heavily sclerotized portion of ductus bursae included within ductus bursae .... *columbiana* (H. Edwards)

Ductus bursae evenly sclerotized, the more heavily sclerotized area being anteriad thereto .... *fletcheri* Rindge

References Cited

Fletcher, D. S. 1959. Notes on North American species of Nycteola (Lepidoptera, Noctuidae). Jour. New York Ent. Soc., 67: 51–52, pl. 8, figs. 1–5.

McDunnough, J. 1943. Phalaenid notes and descriptions (Lepidoptera). Canadian Ent., 75: 59–62, figs. 1–3.

1. Aedeagus of male genitalia of *Nycteola fletcheri*, new species.
2. Female genitalia of same species.

BOOK REVIEW

PSYCHODIDAE. The Seventh Fascicle of Part VI, The Diptera or True Flies of Connecticut, of Guide to the Insects of Connecticut. By Lawrence W. Quate. 1960. Pp. v + 54, 7 plates. Conn. State Geological and Natural History Survey, Middletown. (Distribution and Exchange Agent, Robert C. Sale, Librarian, State Library, Hartford, Conn.).

Dr. Quate, the best-known American authority on the dipterous family Psychodidae, has summarized the available knowledge of his group in a very usable form. The area treated is eastern North America from Virginia to Labrador west to the Great Plains, in which are found 38 species in 8 genera and 3 subfamilies.

Although the psychodids in North America do not represent a threat to man's welfare, they represent a difficult, therefore challenging, assemblage of species for taxonomic study. Dr. Quate keys the subfamilies of the world for adults and larvae, the North American genera for adults, and the northeastern species for the various genera. Species discussions include synonymies, brief descriptions, and distributions, and well-drawn figures of male genitalia, wing venation and antennal characters. He is to be commended for producing such a succinct account of these interesting and little-known flies.

RICHARD H. FOOTE
ENTOMOLOGY RESEARCH DIVISION
A.R.S., U. S. DEPARTMENT OF
AGRICULTURE, WASHINGTON, D. C.

DIPTERA: NEMATOCERA-BRACHYCERA (except Dolichopodidae). By D. Elmo Hardy. Vol. 10 of INSECTS OF HAWAII. (Elwood Zimmerman, series originator and author) 1960. Pp xii + 368, 120 text figs. University of Hawaii Press, Honolulu. $7.00.

Through a National Science Foundation grant, Dr. Hardy has produced a truly remarkable book. It discusses at length 147 species and 5 subspecies of flies in the nematocerous families and

in Stratiomyidae, Bombyliidae, Scenopinidae, and Empididae. Although some of these species occur elsewhere, all occur in Hawaii.

This is the first of 4 projected volumes. Vol. II will contain an account of the Dolichopodidae, Phoridae, and Lonchopteridae; Vol. 12 of Drosophilidae; and Vol. 1 3of the Cyclorrhapha.

In addition to the usual thorough taxonomic treatment accorded all species studied by Dr. Hardy, the book is made especially valuable by the extensive, and sometimes detailed, notes on biology, and the descriptions of larvae in cases where these are known. The illustrations by Marian Adachi Kohn and Arthur Smith are excellent.

Of the groups included, the Cecidomyiidae is of especial interest to this reviewer. This is a family heretofore almost totally unknown in Hawaii and the Pacific; Dr. Hardy is to be congratulated for so successfully making an entering wedge in the study of cecids in that part of the world.

RICHARD H. FOOTE
ENTOMOLOGY RESEARCH DIVISION
A.R.S., U. S. DEPARTMENT OF
AGRICULTURE, WASHINGTON, D. C.

THE STATUS OF CERTAIN MYRMICINE ANTS IN WESTERN NORTH AMERICA WITH A CONSIDERATION OF THE GENUS *PARAMYRMICA* COLE (HYMENOPTERA: FORMICIDAE)

BY ROBERT E. GREGG
DEPARTMENT OF BIOLOGY, UNIVERSITY OF COLORADO

In January, 1957, Dr. A. C. Cole published the description of *Paramyrmica,* a new genus of ants, and of *Paramyrmica colax,* a new species which was designated as the genotype. As Dr. Cole showed, the new genus is closely related to *Myrmica,* from which we may infer it has evolved, and to *Manica.* He also observed that *P. colax* is a social parasite on *Myrmica striolagaster,* or at least an inquiline of some sort, since the two species had formed a mixed colony. The former existed in a much larger proportion than the numbers of its host. I am fortunate to have available several worker paratypes of *colax,* and a study of these specimens with their very unusual structural features, together with their peculiar relationship to a presumed host species as already indicated, lends strong support to the recognition of a distinct genus. The fact that no males of *colax* were found by Cole, however, and that no additional workers (with or without males) have been found since, has raised some doubt about the validity of *Paramyrmica.*

During one past summer, I collected specimens from a colony of ants in far western Colorado near the Utah line, and upon subsequent examination they appeared to represent a new species in the genus *Paramyrmica.* The site from which they were obtained is a pinyon-cedar woodland on a steep hillside, 20 miles north of Loma, Colorado, on the road to Douglas Pass. The elevation is 5700 feet, and the colony was located under a large rock in clay soil. The specimens were taken on August 22, 1960.

After submitting these ants to Dr. W. S. Creighton, it became apparent that they probably represented new samples of a species previously described by M. R. Smith as *Tetramorium rugiventris.* In 1943, Dr. Smith discussed the presence of the genus *Tetramo-*

rium in America, reached the conclusion that the several species of this group now known in the United States are introduced forms, and included among them the newly discovered species, *rugiventris,* which had been collected at Prescott, Arizona. The theory that all our species of *Tetramorium* are tramp species introduced by commerce is ingeniously supported by Dr. Smith, but Creighton (1950, pp. 286–290) presents more cogent reasons for believing that only certain of these ants conform to that explanation, and that *T. caespitum* behaves strikingly as a native insect. On the other hand, Brown (1957) presents a detailed argument in line with Smith's views. He gives very good reasons for removing *rugiventris* from *Tetramorium,* and following this he placed it in the genus *Myrmica,* relating it to *M. striolagaster* and the *M. punctiventris* group.

Workers and a male ant from the Loma colony were sent to Dr. Smith for comparison to the types of his *rugiventris,* and in reply he said that except for a few minor differences in sculpture my specimens may be regarded as belonging to the same species. Through his cooperation, I have also been able to examine three worker paratypes of *rugiventris* in the collection of the U. S. National Museum, and as a result fully confirm Smith's opinion. Smith agrees (in litt.) with Brown, who had seen only the worker, that *rugiventris* belongs in *Myrmica,* and he is even more convinced after studying the male in my sample. With this latter conclusion, however, I am unable to concur as will be shown presently.

In view of the possibility that *rugiventris* may properly be a member of the genus *Myrmica,* I have compared my specimens of the workers to the corresponding caste of certain species of that genus with which they might be allied, and also careful comparisons have been made with Smith's types of *rugiventris.* The results of these studies are as follows, and in each case the structural differences indicate how the compared species departs from the specimens collected in the cited Colorado locality.

T. rugiventris M. R. Smith (paratypes)

1. epinotal spines longer and less triangular
2. thoracic depth (dorso-ventral dimension) deeper
3. gastric rugae finer
4. slightly larger in size
5. color brown, somewhat lighter

The degree of difference in each of these characters, however, is such as one may reasonably expect to find within the limits of specific variability.

M. striolagaster Cole (paratypes)

1. epinotal spines long, sharp, and narrow
2. petiole and postpetiole different in shape
3. frontal lobes turn up
4. prominent lamina at bend of scape
5. clypeal rugae very coarse
6. gastric rugae very fine and striate
7. lateral clypeal lobes lack cariniform ridges
8. size much larger
9. color red brown

It should be stated, nevertheless, that the sculpture of the head, thorax, pedicel, and scapes is in general quite similar.

M. mexicana Wheeler (cotypes)

1. epinotal spines very long and sharp
2. petiole and postpetiole shape and sculpture different
3. frontal lobes turn up; lateral clypeal ridges absent
4. scapes with slight keel at the bend
5. gaster smooth, no rugulae
6. larger in size
7. color red brown

Despite these differences, the dorsal thoracic profile seems to be similar.

M. punctiventris Roger

1. epinotal spines very long and sharp
2. petiole and postpetiole different in shape
3. gaster has coarse piligerous punctures; lacks striation and rugulation
4. clypeus different; antennal scapes slender
5. body sculpture totally different
6. dorsal thoracic profile different
7. larger in size
8. color red brown

M. brevispinosa Wheeler

1. epinotal spines narrow and spine-like though short
2. petiole and postpetiole shape and sculpture different
3. clypeus without lateral lobe ridges
4. scapes slender and narrowed at the base
5. gaster smooth, without striations or rugulae
6. color orange red

Body size in the two ants is about the same.

The preceding comparisons seem to show that *rugiventris* is

not actually a member of the genus *Myrmica,* and that the similarities it shares with several species can be interpreted as convergent. This applies especially to the general rugose sculpture of the head and thorax.

In addition to the preceding comparisons, I have placed males of the Loma colony beside males of the following species of *Myrmica: brevisponsa, punctiventris, lobicornis lobifrons, brevinodis sulcinodoides, spatulata,* and *schencki emeryana.* In all cases the similarities with undoubted species of *Myrmica* were striking, the only differences being those of specific magnitude, such as would appear among the several species listed above. Furthermore, the Loma males run easily through Smith's key (1943) to the genus *Myrmica,* and fit closely his figure of the wing of *Myrmica punctiventris* (p. 285). It would appear from these considerations that we are obliged to regard *rugiventris* as a *Myrmica,* and as both Brown (1957) and Smith (in litt.) state, an aberrant form in that genus. But I do not believe this is necessarily correct. It is established, however, that *rugiventris* must be removed from *Tetramorium,* for the male in that genus is sharply distinguished by its 10-segmented antennae with the second funicular segment extremely long, whereas *Myrmica* males possess 13-segmented antennae with the second funicular segment no larger than its neighbors. The *rugiventris* males conform to the conditions in *Myrmica.*

It is well known that the male sex in ants is notoriously conservative with respect to morphological differentiation. It is frequently impossible to distinguish between closely related species on the basis of the male as they seem identical in outward appearances. For this reason, and also because of the relative infrequency of males in collections, the taxonomy of ants is based mostly upon the worker caste which is constant in ant nests and easily collected, and to some extent upon the female (queen) caste when it is available. The males may be used whenever they happen to present truly distinctive features. Very strong indications of male conservatism can be seen in Smith's key as he found it necessary to combine all the dolichoderine and the formicine genera in one table owing to the extreme difficulty of separating these ants at the subfamily level! Thus it is possible that males of closely related genera in the myrmicines may be structurally undifferentiated at the generic level.

When Cole set up the genus *Paramyrmica* he commented upon various structual features of the worker that seem to be generically distinct, and stressed the fact that the ants gave evidence of being parasites or inquilines, further strengthening his conclusion. Other inquilinous genera are known, of course, in which the parasitic nature of their behavior lends support to their recogition as separate genera, but this is not an absolute requirement as we know for example from the many species of social parasites among species of *Formica,* a group in which most forms are free-living. Hence, it is entirely possible on this score for *Myrmica* to possess an unusual, parasitic species, and *Paramyrmica colax* might conceivably be transferred to *Myrmica,* with *Paramyrmica* possibly reduced to the rank of a subgenus. In the absence of the male of *P. colax,* however, we cannot say whether that sex is identical or even similar to the males of *Myrmica,* and also whether it is in any way similar to the now known males of *rugiventris.* We can only wait until the males of *colax* are discovered, and in the meantime there is ample evidence to defend *colax* as the type of a separate genus, though one closely related to *Myrmica.*

The worker and female of *colax* are decidedly different from any *Myrmicas* I have examined, even *striolagaster,* for the gastric striation of these two ants is not very much alike. The gastric sculpture of *colax* is very coarse by comparison, and in addition the epinotal spines, shape of the petiole and postpetiole, and the form of the scapes in *colax* are notably different from those structures in species of *Myrmica.* It should be emphasized that a fundamental feature of thoracic structure also distinguishes *Paramyrmica (P. colax)* from *Myrmica.* A pro-mesonotal suture is quite obvious in the former, though the joint is not movable, but it is absent in the latter. The significance of the articulation between the pro- and the mesothorax has been discussed elsewhere (Gregg, 1953). Cole mentions this fact in his treatment of *colax,* but does not stress the importance of the pro-mesonotal suture. He also points out that *Manica,* though lacking epinotal spines, does have a well-developed pro-mesonotal suture. *Manica* was *formerly* regarded as a subgenus of *Myrmica.* The entire facies of *colax,* in my opinion, is so striking that I am confident it should be retained in a separate genus even on the basis of the female castes alone. In reference to what has been said above

about males, it is perhaps doubtful whether the male of *colax,* when found, will be of much help in settling the issue in this particular case, unless, of course, it turns out to be distinguished by peculiar traits. That is to say, if the male showed up the same as *Myrmica* males, this fact by itself could hardly outweigh the evidence derived from the singular worker and queen.

It has been necessary to review these details of *P. colax,* for until the generic status of Cole's ant is agreed upon it is impossible to settle the generic status of Smith's *rugiventris* and my Loma specimens which appear to be identical with the latter. I have already compared the Loma ants to paratypes of *rugiventris* and have shown that except for relatively minor differences that might be bridged if a larger series were available for study, the two groups of specimens should be placed in the same taxon. As I have tried to demonstrate, the Loma specimens and the *rugiventris* paratypes are structurally much closer to *colax* than to any *Myrmica,* but at the same time it will be seen that they are specifically distinct. Therefore, I believe they must be referred to the same genus, and as *Paramyrmica* is here recognized as valid for *colax,* it is proposed that *rugiventris* Smith plus my additional sample from Colorado be transferred to *Paramyrmica* as the second known species in that group. The generic characters adduced for the group are shown by *rugiventris* with some deviations to be attributed to species differences. The pro-mesonotal suture is obscured somewhat by the heavy sculpture of *rugiventris,* but it is nevertheless present.

Dr. Smith has called my attention to the fact that a peculiar, angular gibbosity occurs on the clypeus of both *colax* and *rugiventris.* This feature has been checked on paratypes of *colax* and on the Loma specimens of *rugiventris* and has indeed been found to hold true. The character is accentuated by the coarse rugae of the clypeus, and is located where the median lobe joins the lateral lobes of the clypeus on each side and just above the antennal fossa. Such a structural trait is absent in *Myrmica.* Its presence in *Paramyrmica* serves further to strengthen the validity of this genus, and its occurrence on *rugiventris* strongly confirms the placement of that species in the same genus with *colax.*

Dr. and Mrs. G. C. Wheeler (1959) have studied and described the larva of *Paramyrmica colax,* and found it to be closely related

to that of *Myrmica*. However, they showed that the former is generically different from *Myrmica* because it lacks the anchor-tipped hairs and by the similarity of head and body hairs.

In view of the uncertainties and divergent opinions surrounding *rugiventris,* and its current association with the genus *Paramyrmica* recently described, I have chosen to describe all three castes (redescribing the worker) from the specimens collected at Loma, Colorado, with nomenclatural synonymy, and have included the critical characters for differentiating between *rugiventris* and *colax*.

Paramyrmica rugiventris (M. R. Smith) new combination

Tetramorium rugiventris M. R. Smith, Proc. Ent. Soc. Wash., 1943, 45, p. 4, ☿; Creighton, Bull. Mus. Comp. Zool., 1950, 104, p. 292.

Myrmica rugiventris Brown, Breviora, 1957, No. 72, p. 6, ☿.

WORKER Length, 4.28 mm.; head length, 1.07 mm. (excluding mandibles); head width, 0.90 mm. (excluding eyes); scape length, 0.95 mm.; thorax length, 1.35 mm. (excluding pronotal collar); pronotum width, 0.62 mm.; petiole length, 0.45 mm.; petiole width, 0.26 mm.; postpetiole length, 0.40 mm.; postpetiole width, 0.45 mm.; gaster length, 1.13 mm.

Head distinctly longer than broad, sides subparallel and weakly convex, occipital border flat (not concave or excised), and occipital corners well rounded. Clypeus broadly and evenly convex along the anterior border; median lobe about as long as broad, and meeting the frontal area in a deep impression; lateral lobes forming high ridges that border the antennal insertions. Eyes very convex, and protruding beyond the margins of the head, placed approximately midway between the anterior and posterior borders of the head. Frontal area broader than long, and while depressed in front, is not notably set off from the rest of the head posteriorly. Frontal carinae prominent, rectangular, and projecting well over the antennal depressions; merge rapidly with cephalic sculpture posterad. Antennae 12-segmented and stout, especially the scapes, which arise from deep, circular, pit-like insertions. Scape strongly bent at the base, but without tooth or flange surmounting the bend, and narrowed before the condyle; scape surpasses the occipital corner by an amount about equal to its greatest width. Funiculus about ⅓ longer than scape, club indistinctly 4-segmented and merging wtih the remaining funicular segments, which, except for the basal two, are nearly quadrate. Mandibles stout, triangular, somewhat abruptly bent at the base, and furnished with eight teeth. Apical tooth sharp and long, subapical prominent, remainder more or less denticular. Maxillary palpi 6-segmented; labial palpi 4-segmented.

Pronotum moderately convex, broadest through the humeral angles which are rounded; pronotal collar distinct. Mesonotum flat to faintly concave, posterior portion noticeably raised above the metanotum. Pro-mesonotal suture indistinct; meso-epinotal suture clearly marked. Epinotum with a long, sloping base set off from the declivity by a distinct angle, which is crowned

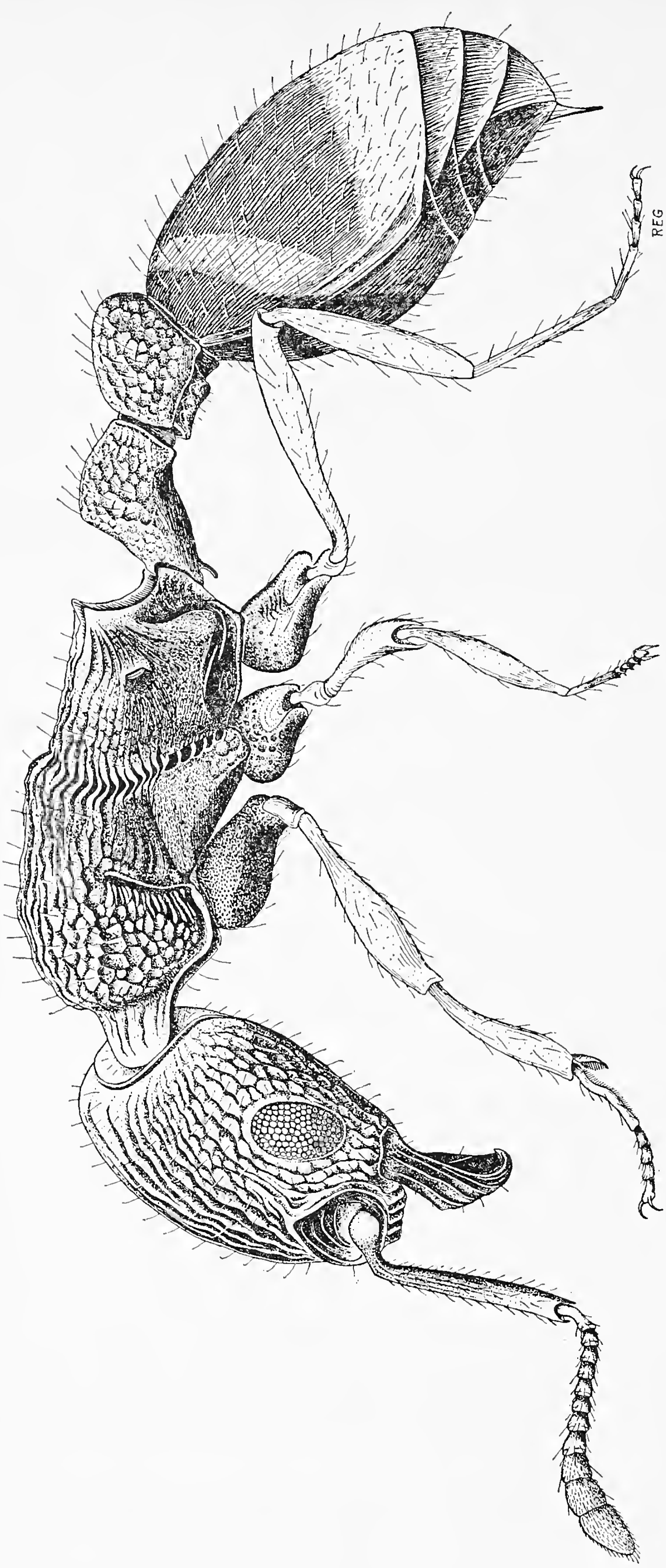

Fig. 1. Worker of *Paramyrmica rugiventris* (M. R. Smith), drawn from a specimen collected at Loma, Colorado. (Magnification, × 58.)

by stout epinotal spines. The spines are triangular, broad at the base, acute at the apex, no higher than long, and appear like prominent vertical teeth; viewed from above the spines are slightly divergent, and at the base continue into anteriorly and posteriorly directed carinae which grade into the sculpture. Flanges bordering the petiolar insertion broad and conspicuous. Meso-epinotal impression (which includes the metanotum) broad and deep, producing a marked gap in the dorsal profile of the thorax. Petiole longer than high, and longer than broad, the node indistinctly separated from the short peduncle; anterior face of the node fairly steep, meeting the summit in an obtuse angle, and posterior face descending at a low angle; from above, the general shape is rectangular. The petiole is armed with a small, narrow, blunt, antero-ventrally directed spine, attached at the anterior end on the venter of the segment. Postpetiole as high as long, and as long as broad; general shape from above, trapezoidal, and broadest near the posterior margin; postpetiole unarmed beneath. Tibial spur of the hind leg barbulate, and of the middle leg barbulate with only a few barbs, as seen under high power of the compound microscope (440 diameters).

Gaster somewhat depressed and only slightly convex dorsally; from above, oval in shape and not truncate basally. Sting well developed.

Sculpture Entire dorsum of the head crossed by coarse, longitudinal, though posteriorly divergent rugae, which become slightly reticulate toward the occipital region and around the eyes. The interspaces possess fine rugules and granules, but these are insufficient to dull the shining surfaces. Clypeal rugae more widely spaced, and the smooth interrugal surfaces shinier. Antennal insertions lined with rugae and granules, and their rims sharply delimited by rugae. Genal rugae reticulate with interspaces granular; subopaque. Gular rugae weaker than elsewhere on the head, and surface coarsely granulate though shining. Mandibles with coarse parallel rugae; interspaces smooth. Scapes covered with longitudinal rugulae and interspaces granular; surface dull; funicular segments granulate.

Thorax coarsely reticulate on most surfaces, though a longitudinal trend of the rugae is evident on the pronotal collar, in the meso-epinotal depression, and on the epinotum; interspaces granulate but shining. Pro-, meso- and epinotal pleurae rugulose-granulate, the granules on the latter two sclerites presenting a longitudinally striated surface which is subopaque. Epinotal declivity and inner aspects of the spines smooth (except for fine shagreening) and very shining. Petiole and postpetiole coarsely reticulate and granulose, the postpetiolar rugae somewhat more longitudinal; surfaces of both subopaque to opaque. Legs granular and coriaceous.

First gastric segment coarsely and longitudinally striated for about ⅔ of its length from the base, with a few very fine interstrial granules; remainder of gaster shagreened, and the whole tagma moderately shining; venter finely shagreened and shining.

Pilosity Hairs pale yellow to whitish, most of them sharply pointed, moderately long, and distinctly erect. Present on all surfaces of the head, funiculi, scapes, mandibles, thoracic dorsum (virtually absent on the pleurae), petiole (except venter), postpetiole, gaster, and all segments of the legs. Pubescence limited to the antennal club; reclinate hairs on the scapes and tarsi are too long and coarse to be considered pubescence.

Color Deep brown to blackish brown; antennal funiculi, scapes, mandibles anterior border of clypeus, pronotal collar, gula, leg articulations, tarsi, petiolar insertion, and tip of gaster, lighter brown to yellowish; protibial spurs and protarsal plantar brushes of hair yellow.

FEMALE Length, 5.63 mm.; head length, 1.13 mm. (excluding mandibles); head width, 1.01 mm. (excluding eyes); scape length, 1.01 mm.; thorax length, 1.80 mm. (excluding pronotal collar); mesonotal width, 0.90 mm.; petiole length, 0.45 mm.; petiole width, 0.34 mm.; postpetiole length, 0.45 mm.; postpetiole width, 0.54 mm.; gaster length, 2.03 mm. (distended); length of anterior wing, 4.61 mm.

Very similar to the worker in color, sculpture, and pilosity, but differs in size and in the usual sclerites and proportions of the thorax in winged castes. Ocelli large but not prominent. Scutum concave on its dorsal surface, scutellum convex, and the suture separating them very distinct; pro-mesonotal suture deeply impressed, especially laterad; tegulae minute. Epinotal base and declivity subequal, the spines forming stout, triangular teeth, broader and less prominent than in the worker. Maxillary palpi 6-segmented; labial palpi 4-segmented; mandibles 8-toothed (2 sharp apical teeth and 6 denticles). Tibial spurs of the middle and hind legs barbulate, as seen under high magnification. Anterior wing with only one discoidal cell; the first and second submarginal cells united, and with them also the first marginal cell, by virtue of the disappearance of the basal part of the radial sector vein. The second marginal cell and the third submarginal cell open distally. Wing membrane very pale brown, hyaline; veins brown and stigma dark brown, opaque.

MALE Length, 4.28 mm.; head length, 0.79 mm. (excluding mandibiles); head width, 0.73 mm. (excluding eyes); scape length, 0.35 mm.; thorax length, 1.58 mm. (excluding pronotal collar); mesonotal width, 0.89 mm.; petiole length, 0.45 mm.; petiole width, 0.23 mm.; postpetiole length, 0.34 mm.; postpetiole width, 0.39 mm.; gaster length, 1.24 mm. (distended); length of anterior wing, 3.83 mm.

Head posterior to the eyes semi-circular, occipital angles very rounded; sides of head converging in front of the eyes to an obtuse angle with the clypeus, the free border of which is broadly convex. Median lobe of the clypeus convex, lateral lobes forming high ridges surrounding the deep antennal insertions. Eyes protuberant, semicircular in outline, and placed slightly anterior to the middle of the head. Ocelli prominent but not raised on a tubercle. Mandibles strong, triangular, similar in shape to those of the worker, and furnished with 5 sharp, subequal teeth. Maxillary palpi 6-segmented; labial palpi 4-segmented. Antennae 13-segmented; scape straight and not bent at the base, equal in length to the first two funicular segments; funiculus long and slender, its segments 1½ to 2½ times as long as broad, and the five terminal joints increasing in thickness but the antennal club very indistinct.

Mayrian furrow and parapsidal furrows of the thorax distinct. Scutum centrally depressed posterad; scutellum slightly raised and convex. Thorax broadest through the mesonotum at insertions of the anterior wings; anterior to this point, the sides flat but strongly converging to the neck-like pronotal collar. Tegulae minute. Epinotal base and declivity strongly inclined and

forming essentially a single continuous surface; declivity faintly concave, and the epinotal angles marked only by spines which are reduced to broad, blunt, triangular teeth. Petiole when viewed from above subrectangular, twice as long as broad, and slightly narrowed anteriorly; peduncle very short; node low and flat, with the anterior face abrupt and steep, posterior face sloping gradually downward. Postpetiole from above trapezoidal, narrowed in front; in profile rising gradually to the rear, highest near the posterior border, and with steep posterior face. Middle tibial spurs barbulate-pectinate (with strong broad barbs), and hind tibial spurs decidedly pectinate, as seen through high magnification.

Gaster slightly obovate, with narrow end at the base; somewhat flattened, and with sides faintly marginate. Genitalia well developed, largely concealed in repose but prominent when exserted; stipites long and convex; volsellae furnished with a C-shaped or hooked terminal lobe; sagittae blade-like.

Sculpture Much reduced as compared with that of the worker and female. Longitudinal cephalic rugulae few and faint on the frons and vertex, reticulate above the antennal insertions and on the genae; remainder of head, including the gula, heavily granulate, opaque. Mandibles delicately striate; scape faintly granulate. Pronotum granular, opaque; pronotal collar rugulose. Vertical face of mesonotum granular but shining; space in front of the wings of the Mayrian furrow smooth in the middle and strongly shining, behind the furrow granular, striate, and moderately shining. Scutellum punctate and subopaque. Metanotum granular, opaque. Epinotal base granular and longitudinally rugulose but shining; declivity granular and shining. Propleurae granulose, subopaque; mesopleurae and epinotal pleurae rugulose granulate and subopaque to weakly shining. Petiole entirely granulose and subopaque. Postpetiole rugulose granulate and subopaque; except postero-dorsally where it is nearly smooth and moderately shining. Gaster shagreened, especially the first segment, but striations (as in worker and female) are absent save for a few at the extreme base. Gaster rather strongly shining.

Pilosity Hairs delicate, pointed, erect to suberect, and pale yellow to white. Present, as in the worker and female, on practically all surfaces of the body and appendages, except the pleurae, epinotal declivity, and the eyes.

Color Black, except for antennae, mandibles, and leg insertions which are brown, and tarsi and genitalia which are yellowish.

Wings Venation and cells identical with those of the female. Color pale brownish yellow, hyaline; stigma brown, translucent.

Material examined 25 workers, 6 alate females, and 26 males taken from a colony at the site described 20 miles north of Loma, Colorado. Three paratype workers of *Tetramorium rugiventris* Smith were also studied as explained previously.

The worker of *Paramyrmica rugiventris* differs from paratypes of that of *P. colax* Cole in the following particulars: overall size smaller (*colax* body length, 5.51 mm.) and also in the sizes of the various body parts measured; in color, *rugiventris* is dark brownish black (*colax* reddish brown); sculpture on all parts of the body coarser (rugae heavier and inter-reticular

spaces larger and deeper), gula granular (*colax* reticulate), petiole granulo-reticulo-rugose (*colax* granulo-rugose), postpetiole reticulo-rugose with faint granules (*colax* granulo-striate), gastric striae coarse (*colax* finer); epinotal spines shorter, broader, and more tooth-like; erect hairs present on dorsum of pronotum, mesonotum, epinotum, petiole, postpetiole, and first segment of gaster (hairs appressed, a very few strongly reclinate, on these areas in *colax,* in other places erect to reclinate). The differences in pilosity should be seen to be fully appreciated, but they are very striking features of these two ants. The ventral petiolar spine is proportionately longer and more slender in *rugiventris* than in *colax.*

Though Cole described *Paramyrmica colax* as a social parasite of *Myrmica striolagaster* Cole, I did not find any of the latter species associated with *rugiventris,* nor any other form of host. Three suggestions are possible in this situation: (1) *P. rugiventris* is not a parasitic species but establishes its nests independently, or (2) the nest found, having male and female reproductives, may have been a mature colony from which all specimens of a supposed host had disappeared, or (3) my search may not have been adequate to uncover the host species. *M. striolagaster,* however, according to recent records we have obtained, does occur in western Colorado. It has been collected near Rifle, Grand Junction, and in Mesa Verde National Park, and presumably could serve as host to *rugiventris.* Also, other species of *Myrmica* might be the host, or even some other genus, but more search will be necessary to provide the answer to this question.

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PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

Meeting of October 7, 1958

Ed. Note: Proceedings last appeared in the Sept.–Dec. 1959 issue of the *Journal.*

The President, Doctor Asher Treat, called the meeting to order at 8:05 PM in Room 419 of the American Museum of Natural History. Nineteen members and seven guests were present. Mr. Shoumatoff gave a list of the programs that were planned for the fall. In the absence of the Editor, Mr. Soraci, Mr. Metterhouse reported that the printer now has all material for the 1958 issues; the JOURNAL will be up-to-date in 1959 and be brought back to a quarterly publication schedule. Dr. Treat, reporting on the October 2nd meeting of the Executive Committee, stated that a letter file for the Society archives has been purchased and installed on the fifth floor of the Museum. The ZOOLOGICAL RECORD fund was oversubscribed, and the remaining money will be designated for future contributions by the Society.

Mr. Tony Roberts, President of the Junior Society, told the members how it was faring in the absence of Miss Alice Gray who will be in California for at least a year. He stated that a number of Society members had volunteered to speak to the Juniors. A motion was passed, offered by Dr. Schneirla, that the President write Miss Gray to again thank her for her work with the Junior Society and to wish her well in her researches on the Protura.

The program consisted of the traditional report by members on their summer activities. The membership was about equally divided between those who remained in the New York area and those who ranged across a number of continents. Among the stay-at-homes, Mr. Bloch battled insecticide-resistant roaches; Dr. Treat showed the members his summertime associate "Kelly" (*Chelifer cancroides*), a pseudo-scorpion who visited his attic workshop in Massachusetts; Dr. Teale and Mr. Farb both worked on books; Mr. Brush noted a marked decrease in the number of yellowjackets; Mr. Farb reported these insects were practically absent from the Lake Waccabuc area, too. Dr. Klots attributed this absence possibly to skunks which can clean out an entire nest. Dr. Vishniac worked at Woods Hole observing schooling in Collembola and protozoa. Among our more fortunate members, Tony Roberts divided his time between Europe and New York; Mr. and Mrs. Heineman visited Cyprus and the Greek islands and a number of European collections; Mr. Shoumatoff showed colored slides of his butterfly collecting trip to Switzerland; Mrs. Hopf of her trip to Mexico and the western states; Dr. Schneirla studied army ants in the southwestern regions; Dr. Pohl visited his entomological friends in France, examined some insect collections, and was subjected to a bomb scare on his airplane flight back to the United States. The meeting adjourned at 10:05 PM.

Peter Farb, *Secretary*

MEETING OF OCTOBER 21, 1958

Dr. A. Treat called the meeting to order at 8:05 PM in Room 419 of the American Museum of Natural History. Fifteen members and eight guests were present. Mr. Watsky of the Junior Society reported they were receiving excellent assistance from the Senior members; Mrs. P. Vaurie, Dr. E. Teale, and Mr. J. Pallister taking over recent meetings. Mr. E. Gene Patterson of 61 West 83rd Street, N. Y. 24, N. Y. was proposed for membership.

The program for the evening was a report by Dr. A. B. Klots on the International Colloquium for Zoological Nomenclature which he and Mr. Cyril dos Passos attended as delegates of the Society in London during July. Dr. Klots traced the recent history of zoological nomenclature, pointing out that an attempt to write a set of rules to cover every possibility resulted in no workable rules at all. The tinkering with the old code began in 1931, and, at a meeting in Paris in 1948, radical changes were made. Only five years later, the first colloquium was called to revise the rules. This second colloquium resulted in rewriting the code and establishing a permanent body to consider conflicts in classification and terminology. The code was presented to the 15th International Congress of Zoology and passed substantially as written. Dr. Klots reviewed the primary provisions of the code. He concluded his talk with color slides taken at the colloquium, as well as insect and plant life in England.

After a discussion period the meeting adjourned at 10:00 P.M.

PETER FARB, *Secretary*

MEETING OF NOVEMBER 18, 1958

The President called the meeting to order at 8:05 PM in Room 419 of the American Museum of Natural History. Twenty-one members and 23 guests were present. Dr. Treat appointed a Nominating Committee, consisting of Dr. Clausen, Chairman, Dr. Forbes, and Mr. Heineman, to present a slate of officers at the Annual Meeting on January 6th, next. The President announced that the March 1959 issue of the JOURNAL will bring the Society's publication up-to-date. In order that the JOURNAL may continue to be published quarterly and to meet the increased costs of printing, the Executive Committee voted to increase the annual subscription rates from $2 to $5 for active members of the Society, and from $5 to $8 for non-members and institutions. The annual membership dues wil remain at $4 as established by the By-laws; the total for membership dues and subscription will be $9 per year. He stated that this change has long been anticipated and delayed as long as possible. The Executive Committee also recommended that the By-laws be amended authorizing the establishment of a student membership to terminate at 21 years of age, the annual subscription price for this type of membership to be set at $3. Although the By-laws empower the Executive Committee to set JOURNAL rates, Dr. Treat requested a vote of confidence by the membership for the action of the Committee; this was given unanimously.

Dr. Klots proposed the following amendments be made to the By-laws to establish a category of student membership (new material italicized):

ARTICLE I

The Society shall consist of active (*delete comma*) *members, student members,* life *members,* and honorary members.

1. (no change.)

2. *Eligibility for student membership shall be limited to persons interested in entomology who shall not have reached 21 years of age.*

3. (Same as present section 2, but renumbered.)

4. (Same as present section 3, but renumbered.)

ARTICLE VII

The dues of active members shall be Four Dollars ($4.00) (*delete comma*) per annum, *of student members, Two Dollars ($2.00) per annum,* payable in advance on the first day of January each year.

The proposed amendments are to be voted upon at the regular meeting of December 16, 1958.

Mr. E. Gene Patterson was elected to membership and Mr. Jack Alson of 1306 Avenue H, Brooklyn 3, N. Y. was proposed for membership.

Dr. Klots then introduced Dr. Edwin Way Teale who presented the evening's program—"20,000 Miles of American Nature." Through the use of colored slides, Dr. Teale told the story of a trip taken by himself and his wife to witness an American summer. Their route led from Long Island to Mt. Mansfield, Vermont, then westward to the Great Lakes where they encountered Mayfly swarms. The slides illustrated the tour around Lake Michigan, orchids of Wisconsin, buffalo in the Dakotas, and a prairie dog colony in Devil's Tower National Monument. Dr. Teale felt that the three states with the greatest appeal to the naturalist were California, Florida, and Colorado; much of the latter part of his trip was spent in Colorado. The trip ended with the last day of summer spent on the summit of Pike's Peak.

The meeting adjourned at 9:45 PM.

PETER FARB, *Secretary*

MEETING OF DECEMBER 2, 1958

President Treat called the meeting to order at 8:05 PM in Room 419 of the American Museum of Natural History. Twenty members and 10 guests were present. The minutes of the previous meeting were approved as read. The guests were welcomed. It was announced that the Executive Committee has decided to defer the change in the subscription rate until the JOURNAL is up to date. Mr. Jack Alson was unanimously elected to membership. Mr. Bernard Heineman proposed Mrs. Heineman for membership. The By-laws were suspended by the members present and Mrs. Heineman was immediately elected.

The speaker of the evening, introduced by Dr. Treat, was Dr. Mont A. Cazier, Chairman of the Department of Insects and Spiders of the Museum, who told about "The Southwestern Research Station." Dr. Cazier is also the Director of the Station, a division of the Museum, which is located in southeastern Arizona near Portal. Interesting facts about the background

and uses of the station were given and the speaker stated he believed it to be the best in the United States even though there are about 400 such stations in the country. Accommodations are available for 53 persons or 10 families in buildings; many more can be put-up in tents. So far 313 senior and 299 student investigators have been accommodated during the three year period the station has been in existence. Color slides of the station and surrounding countryside were shown and explained. Questions were answered by Dr. Cazier. He was thanked by the membership for his excellent talk.

The meeting adjourned at 9:30 PM.

ROBERT G. BLOCH, *Assist. Secretary*

MEETING OF DECEMBER 16, 1958

President Treat called the meeting to order at 8:05 PM in Room 419 of the American Museum of Natural History; 16 members and 7 guests were present. The minutes of the previous meeting were approved as read. Dr. Treat commented that both Mr. and Mrs. Heineman were elected to membership in January, 1925. Thus, the election of Mrs. Heineman at the last meeting reinstated her. Mr. Shoumatoff announced that at the next meeting, the Annual Meeting, refreshments will be served. Mrs. Lohning and Mr. Huberman were appointed Refreshment Committee for the meeting. Mr. Michael Shulgin of 241 Concord Road, Yonkers, N. Y. and Mr. Sol Lander of 4217 16th Ave., Brooklyn, N. Y. were proposed for membership. The proposed amendments to the By-laws were then read (Cf., minutes of the Nov. 18, 1958 meeting). A motion was made, seconded, and unanimously passed to adopt these amendments.

Dr. J. Forbes introduced the Rev. Dominic Do-Van-Qui, a graduate student of Fordham University, who was the speaker of the evening. He discussed "The Reproductive System of the Black Carpenter Ant Queen, *Camponotus pennsylvanicus*." The anatomy and histology of the system was described. Particular attention was devoted to the structure of the seminal receptacle and its possible mode of functioning. His talk was illustrated with slides. A lively question and answer period followed.

The meeting adjourned at 9:40 PM.

ROBERT G. BLOCH, *Assist. Secretary*

MEETING OF JANUARY 6, 1959

President Treat called the meeting to order at 8:10 PM in Room 419 of the American Museum of Natural History. The minutes of the previous meeting were accepted as read. The 16 members and seven guests were welcomed by the President. Dr. Treat reported on membership, finances, the By-laws, and the advancement of Entomology for the past year. Mr. Soraci announced that he has high hopes of the JOURNAL being brought up to date with the March issue.

The Nominating Committee presented the following slate of officers for the coming year:

President .... Mr. Nicholas Shoumatoff
Vice-president .... Mr. Bernard Heineman

Secretary	Mr. Robert G. Bloch
Assistant Secretary	Mr. Raymond Brush
Treasurer	Mr. Jacob Huberman
Assistant Treasurer	Mrs. Patricia Vaurie
Editor	Mr. Frank Soraci and Publication Committee as presently constituted: Mr. F. Soraci, Dr. W. Creighton, Mr. H. Schwarz, Mr. P. Farb
Delegate to the New York Academy of Sciences	Dr. Lucy W. Clausen
Trustees	Mr. E. Irving Huntington Mr. Herbert F. Schwarz Dr. Alexander B. Klots Dr. John Schmitt Dr. Asher Treat

The nominations were closed and the entire slate elected by the Secretary casting one ballot. A telegram was received from Mr. and Mrs. Heineman congratulating Dr. Treat on his successful year and wishing success to Mr. Shoumatoff for the ensuing year.

Mr. Huntington then presented Dr. Treat with a silver tray inscribed "Asher Treat with deep appreciation from New York Entomological Society 1958" as a token of appreciation for his untiring efforts toward keeping the Society together and rejuvenating it. Dr. Treat in response said that without the help of many members and past-presidents his year could not have been successful. Dr. Vishniac called for a vote of gratitude to Dr. Treat. This was unanimously given by the entire group present.

Three persons were elected to membership; Mr. Michael Shulgin, Mr. Sol Lander, and Miss Lenore Grossman; in this latter case the By-laws were suspended.

Mr. Herbert Schwarz was nominated for Honorary Membership in the Society by Dr. Treat. This was quickly seconded and unanimously passed by the members present. The retiring president's talk was concerned with "Developments in Acarology." (An abstract follows the minutes.)

The meeting adjourned at 9:50 PM.

ROBERT G. BLOCH, *Secretary*

DEVELOPMENTS IN ACAROLOGY

Abstract

Though known in literature since the time of Aristotle, the mites and ticks (Order Acarina) were first designated as Arachnida along with spiders and scorpions, by Lamarck in 1815. They were dealt with systematically by several 19th century workers from Latrielle in 1806 to Canestrini in 1892, but because of their minuteness they have only recently become objects of extensive study, still largely descriptive. Probably only a small percentage of the existing species are known. Military medical and agricultural problems of the past two decades have awakened much interest, as indicated by Brennan's list (1958) of 411 acarologists of the world. Courses of instruction in acarology are now given at the State Universities of Maryland, California,

and Kansas. Five suborders and about two hundred families of Acarina are now recognized. These represent virtually every known climate, habitat, and mode of ecological relationship. Among the results of recent research is detailed knowledge of the life cycle of the various chigger mites some of which cause dermatitis while others are vectors of disease such as scrub typhus. Certain soil-dwelling mites of the supercohort Oribatei have been shown to harbor the eggs of tapeworms infesting sheep and other animals including man. Mite control has become an important problem where predator populations have been reduced by man. Mites and insects are often intimately inter-related, as illustrated by the moth ear mite, *Myrmonyssus phalaenodectes.*

A. E. Treat

Meeting of January 20, 1959

Our new President, Mr. Nicholas Shoumatoff, called the meeting to order in Room 419 of the American Museum of Natural History at 8:00 PM., 18 members and 3 guests were present. The minutes of the previous meeting were read and accepted as read. The only committee report was from the Treasurer who reported that the "status quo" was being maintained. Dr. Daniel Ludwig of the Biological Laboratory, Fordham University, was proposed for membership.

The death of Dr. Heinrich E. K. Jordan in London was brought to the attention of the meeting by Mrs. Alice Hopf. She submitted an obituary from the NEW YORK TIMES which was read by Mr. Shoumatoff. Dr. Treat, Dr. Louis Marks, and Mr. Shoumatoff spoke of the late Dr. Jordan and described his great contributions to entomology and they related anecdotes of his productive and colorful life. A resolution proposed by Dr. Treat to express the sympathy and to extend the condolences of our Society to the Royal Entomological Society and or other Scientific organizations with which the late Dr. Jordan was closely allied was unanimously passed.

Mr. Shoumatoff re-introduced himself as the speaker of the evening and presented a most informative and interesting, illustrated talk on Afghanistan butterflies. The personalities of some of his colleagues were included, together with the geography of Afghanistan and its environs. (An abstract follows the minutes.)

The meeting was adjourned at 9:50 PM.

Raymond Brush, *Assist. Secretary*

STUDIES OF AFGHANISTAN BUTTERFLIES

Abstract

Because of political and physical difficulties of access, the highland butterflies of Afghanistan have remained little known relative to other parts of Central Asia. They have been a large gap in the zoological knowledge of the entire region, whose lofty mountains have produced important problems of distribution and taxonomy for the lepidopterist. A collection of butterflies from central Afghanistan, especially the Koh-i-Baba Range rising to 5143 meters, by the third Danish Expedition to Central Asia in 1948, was a

major breakthrough. These have been reported by Avinoff and Sweadner (Annals of the Carnegie Museum, 1951) and by Clench and Shoumatoff (Vidensk. Medd. fra Dansk, Naturk. Foren, 1956). This collection of over 900 butterflies in 62 different forms, resulted in 6 new species, 12 new subspecies, and 17 additional forms recorded from Afghanistan for the first time. The novelties included *Pseudochazara porphyritica, Paralasa danorum, Karanasa pamira haslundi, Colias shahfuladi,* and *Parnassius delphius kohibaba,* each of which exemplify zoogeographical situations of special significance. The presently known Afghan butterflies are 109 distinct species and 16 additional subspecies, of which 11 species and 30 subspecies are endemic. Recently the Carnegie Museum, through a grant from the late A. Avinoff, acquired a much larger new collection of Afghan mountain butterflies, made by H. Klapperich of Germany, which includes 761 *Satyridae,* 960 *Nymphalidae* etc., 2210 *Lycaenidae,* 1557 *Pieridae,* 635 *Papilionidae,* and 413 *Hesperidae.* These are now being studied in cooperation with specialists from England and Germany and promise to yield much new knowledge of the Central Asiatic fauna.

NICHOLAS SHOUMATOFF

MEETING OF FEBRUARY 3, 1959

President Shoumatoff called the meeting to order at 8:10 PM in Room 419 of the American Museum of Natural History. Twenty-three members and eight guest were present and they were welcomed by Mr. Shoumatoff. The minutes of the previous meeting were read and approved. The President welcomed back to the United States our Vice-president, Mr. Heineman, who then gave a report of the programs for the next two months. Dr. A. B. Klots, Chairman of the Field Committee, is planning to have two or three field trips this year. He stated that Mr. and Mrs. Ruben have offered their grounds in Orange County for one of the trips. Dr. Daniel Ludwig was elected to membership and Mr. John Yrizarry was proposed for membership in the Society.

Mr. Shoumatoff introduced the speaker of the evening, Dr. Klots, who spoke on "Thrips, Walking Sticks, and Other Insects." His many color slides beautifully illustrated his most informative talk.

The meeting adjourned at 10:00 PM.

ROBERT G. BLOCH, *Secretary*

MEETING OF FEBRUARY 17, 1959

President Shoumatoff called the meeting to order at 8:15 PM in Room 419 of the American Museum of Natural History; 17 members and one guest were present. The minutes of the previous meeting were read and approved. Mr. Huberman, the Treasurer, reported the amount of $952 in the General Fund and $5150 in the Capital Fund. Mr. John C. Yrizarry was unanimously elected to membership. A motion was made, seconded, and passed to allow the Quartermaster Research & Engineering Command, U. S. Army to republish articles from the JOURNAL of the New York Entomological Society.

A copy of Dr. A. B. Klots' book on butterflies and moths was shown and passed around; Mr. Shoumatoff recommended it to the membership.

Dr. J. Forbes introduced the speaker of the evening, Dr. Eleanor Lappano, who spoke on "Army Ant Larva." Her talk was illustrated with lantern slides. She related the external and internal morphology of larvae of *Eciton burchelli* to its behavioral pattern. (An abstract follows the minutes.)

After a discussion period the meeting adjourned at 9:50 PM.

ROBERT G. BLOCH, *Secretary*

ARMY ANT LARVA

Abstract

A study of the external and internal anatomy of the army ant larva, *Eciton burchelli,* was undertaken to determine whether differences in structure or in developmental growth rates exist among the various polymorphic castes or size-groups of an all-worker brood of this species. This investigation was part of her doctoral research which was conducted at the American Museum of Natural History and at Fordham University.

The results indicated that no single external or internal structure or its progressive development could alone be used to distinguish larvae of the different polymorphic size groups. Rather, in any one developmental stage, between the extremes in body length, a smooth series of measurements is found to exist with corresponding differences in the size and degree of development of the particular external or internal structure being considered.

These studies did reveal a more rapid rate of leg disc dvelopment in larvae of the smallest size-group when compared with the rate of development of these structures in the middle-sized and the largest-sized individuals. A sequence of histological and cytological changes in the development of the salivary gland was observed which, when viewed in the light of previous studies of the behavioral pattern of these social insects (T. C. Schneirla, 1933–present), provided a link in understanding the biology of these interesting insects. The rate of development of the leg discs was compared with the rate of development and functional activity of the salivary glands.

There is a two-fold function of the salivary glands in *Eciton burchelli.* First, they are the site of production of a nutritive secretion during early larval development; this is believed to be related to trophyllactic activities between brood and workers. Second, they are the sites of formation of the spinning material during the pre-pupal period of development; this material is used to spin the cocoon at the onset of the pupal period of metamorphosis. These two activities were discussed in relation to the behavioral pattern of these insects.

ELEANOR R. LAPPANO

MEETING OF MARCH 3, 1959

President Shoumatoff called the meeting to order at 8:10 PM in Room 419 of the American Museum of Natural History. The minutes of the previous meeting were approved as read. The President welcomed the 13 members and 11 guests who were present. The Program Chairman, Mr. B. Heineman, listed the programs for the meetings through May. It was announced

that Theodore Weinreich has been elected President of the Junior Society. On March 28th that group will have Mr. Heineman to talk on "Butterfly Collecting in Jamaica." Dr. A. Treat urged the Senior membership to support the Juniors in volunteer help, such as helping them to have their own field trips, etc. The Society is indebted to Mr. Herbert Schwarz for his gift of $250.00 which insures the use of our meeting room for another year.

Dr. A. Klots then introduced the speaker of the evening, Dr. Jane Brower, who spoke on "Experimental Studies of Mimicry." Her talk, illustrated with lantern slides, described how Scrub Jays and Starlings were taught to reject the Monarch butterfly, and thereafter they rejected its mimic, the Viceroy. (An abstract follows the minutes.)

After a discussion period the meeting adjourned at 9:45 PM.

ROBERT G. BLOCH, *Secretary*

EXPERIMENTAL STUDIES OF MIMICRY

Abstract

Experiments were designed to test the effectiveness of mimicry in butterflies. It was shown by experiments with caged Scrub Jays (*Cyanocitta coerulescens*), that the model butterfly *Danaus plexippus* (Monarch), is unpalatable. Although the birds pecked the model at first, they soon learned to reject it on sight alone, and never ate it. Then when they were given the mimic, *Limenitis archippus archippus* (Viceroy), in place of the model, the birds also rejected this on sight alone in a number of trials, and never ate it.

A group of control birds, which were not given the model, ate the mimic in the majority of trials. Both experimental and control birds ate all of the butterflies designated as Edibles, which were given randomly in sequential pairs with the model or mimic.

DATA:

No. of Viceroys	Experimental Birds (4)	Control Birds (4)
Not Touched	42	10
Eaten	0	60

The rejection of the Viceroy (mimic) by the experimental birds is attributed to their experience with the unpalatable Monarch (model). These birds treated the Viceroy as though it were the Monarch, thereby indicating that mimicry is effective under the conditions of the experiment. These experiments appear as three articles in *Evolution*, 1958 (Mar., Jun., and Sept.)

In another series of experiments, the effect of the proportion of artificial models and mimics on mimicry was studied. The results indicated that Starlings *(Sturnus vulgaris)* receiving 10%, 30%, and 60% mimics (the balance being models in each case) did not eat 80% or more of the mimics given. A Starling which got 90% mimics failed to eat 17% of those given; a control bird, which got 100% mimics, ate them all. These experiments are the first to suggest that mimicry may be more effective than had been supposed under conditions in which mimics outnumber models. These will be repeated with various proportions of model and mimic butterflies.

JANE VAN ZANDT BROWER

COMMUNICATION RECEIVED NOVEMBER 11, 1961

Word has been received that the Zoologische Museum de Humboldt-Universitat in East Berlin can no longer be visited by scientists of the western zone. Scientists associated with the Museum who live in the western zone have been relieved of their positions.

This ban includes the well-known Coleopterist, Doctor Kurt Delkeskamp, a specialist on African Erotylidae whose association of thirty one years has been abruptly terminated.

INDEX TO SCIENTIFIC NAMES OF INSECTS AND PLANTS

VOLUME LXIX

Generic names begin with capital letters. New genera, subgenera, species and varieties are printed in italics. This index does not include names published in the list of Lycaenidae (J–N).

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